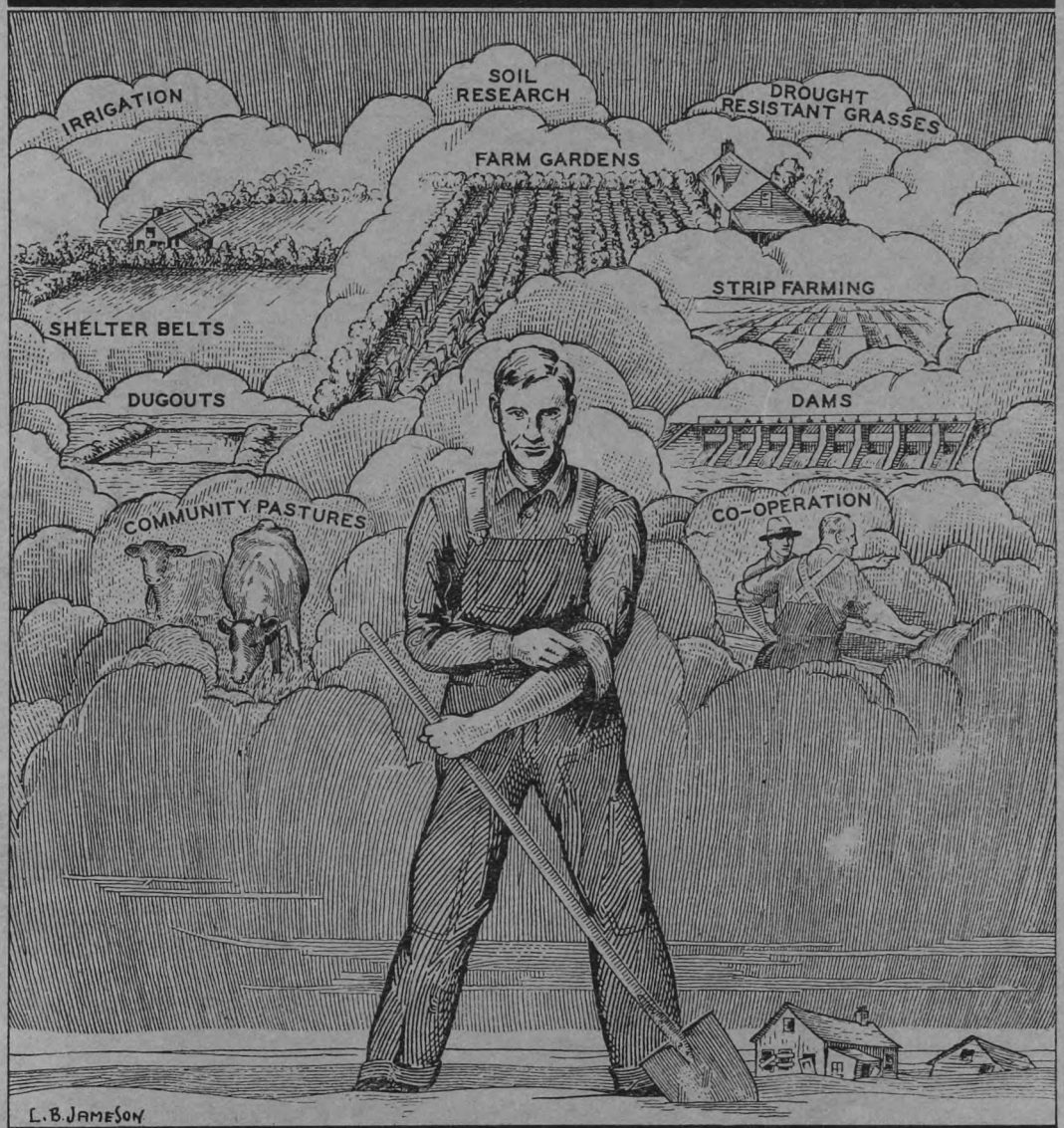
CSTA review

Disp.

PRAIRIE FARM REHABILITATION



CANADIAN SOCIETY OF TECHNICAL AGRICULTURISTS

PRAIRIE FARM REHABILITATION

CONTENTS

REPRINTED FROM THE DECEMBER, 1939, ISSUE OF THE

C.S.T.A. Review

PUBLISHED QUARTERLY BY THE

CANADIAN SOCIETY OF TECHNICAL AGRICULTURISTS

OTTAWA, CANADA

C.S.T.A. REVIEW

Published Quarterly by the

CANADIAN SOCIETY OF TECHNICAL AGRICULTURISTS

NUMBER 23 DECEMBER, 1939

EDITORIAL COMMENT

THIS ISSUE of the *C.S.T.A. Review* is designed to acquaint agriculturists and other interested parties throughout Canada with the activities of the Prairie Farm Rehabilitation Act, or what is commonly called the P.F.R.A.

The articles contained in this issue do not present the picture from the point of view of what has actually happened, such as the serious soil drifting problem, the distressed condition of the farmers during the dry years, the drought movement of live stock, etc. The C.S.T.A. believes that the people of Canada know this situation well enough without repeating it in this publication. This issue has been planned with a view to acquainting people with what is being done to correct the situation and the policies under way to meet recurrent adverse climatic conditions in future years.

The P.F.R.A. has functioned since April, 1935. Since that time many important changes have been made. It may be said that its work is just in the pioneer stage. The articles discuss some of the preliminary steps which have been taken. Much yet remains to be done. Time is necessary to correct the mistakes of bygone years. Besides the agricultural problems, there are the social and human problems which must be handled with understanding and common sense. It will take many years for readjustment and the results will not possibly accrue until the next generation are the leaders.

The outlook for permanent rehabilitation in Western Canada is encouraging. Farmers are fully conscious of their responsibility for the future. They know that measures must be taken to meet future dry years. The P.F.R.A. is helping the situation and is giving guidance. The return of good crops in 1939 is no doubt the crowning feature, however, because it is enabling people to live and to have a few dollars to do those things that they knew should have been done several years ago.

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Subscription rate is $1.50 in Canada and other parts of the British Empire, the United States, Mexico, France, Spain, Central and South America; in other countries, $2.00.

Giving Permanence

The low-rainfall years of the past decade serve to emphasize the fundamental fact that in spite of mechanization, farming on the prairies is a mode of living or a way of life where the home cannot be considered apart from the farm as a whole. The widespread and devastating effects of drought demonstrate the necessity of making the home the central factor in establishing any kind of permanent agriculture on the open plains and in placing farming in this area on a self-sustaining basis.

W. L. JACOBSON (PAGE 58)

Foreword

By the Honourable J. G. Gardiner*

The work carried out under the Prairie Farm Rehabilitation Act is, as the name suggests, for the purpose of rehabilitating the areas affected by the drought years. In carrying out this work due attention is being paid to the mistakes of the past and new policies are being put into effect in an orderly fashion. Practically every angle of the question is receiving attention. When small-scale irrigation schemes can be operated successfully that is being done. Aid is given to farmers in obtaining water supplies for stock in the building of dugouts and stock watering dams. Regrassing projects are being carried out. Experimental work on new varieties of plants and also in cultural methods is also going forward and the results being applied. A thorough soil and economic survey of the land is being made in order to plan for the future the most practical land utilization possible. Already some phases of a land utilization scheme have been put into effect. Settlers on sub-marginal lands have been moved and many large areas of such lands have been fenced to provide community pastures for live stock.

The whole rehabilitation project is being considered in the light of other policies of Governments. For instance in the community pasture project well-bred sires are being provided so that good quality cattle may be secured to supply the fresh beef trade in the United Kingdom market. Already experimental shipments have been made and it is hoped to obtain additional supplies from the community pasture project in the future. It is believed a new market for Canadian fresh beef can be built up.

Debt adjustment is also of direct concern to farmers in the drought area and the various Governments have fostered wide scale adjustments in farm debt.

The policy in regard to wheat growing and marketing must, of course, be considered in any general program dealing with the West. Three methods of marketing wheat are available to the Western farmer; the Wheat Board with a guaranteed price, the open market, and the co-operative way under the Wheat Co-operative Marketing Act. In addition, for relief of wheat growers in years of very low prices, or low yields or both, an Act has been passed to provide acreage payments to farmers who suffer crop losses.

The application of the Prairie Farm Rehabilitation Act, as described in succeeding articles, forms part of the program in rehabilitating the West. These other policies, of markets, debt adjustments, and crop insurance are equally important. The whole policy points to a single idea, that of keeping the farmer on the farm in a prosperous, contented home.

*Minister of Agriculture, Dominion Department of Agriculture, Ottawa.

A Land Utilization Plan for Prairie Agriculture

By E. S. Archibald*

The title does not presume to infer that the question of planned agriculture for Western Canada has not been given most careful study over a long period of years. Unfortunately the wise counsel of many leaders was not followed during the period of settlement nor in subsequent years of what might be termed "normal precipitation" and fair prices. Only the desperation caused by the recent nine consecutive years of extreme drought and ravages by insects has impelled the adoption of the best available advice, moulding it into a definite framework on which to build a sound land utilization plan for the future.

It is not to be wondered that mistakes were made in the settlement and establishment of a type of agriculture in the short-grass plains of the Prairie Provinces. No precedents existed in Canada or elsewhere on this continent. Early settlers in Manitoba and eastern Saskatchewan faced great risks in garden and grain production from frost, drought, and high winds. Dr. Angus Mackay in his Experimental Farm Report for the years 1887-1889 emphasized this fact. Shortly thereafter the summer-fallow, introduced by that institution, aided so greatly in overcoming shortage of soil moisture for the growing crops that production with reasonable safety expanded rapidly west to the Rockies and north several hundred miles.

Frost, an equally great risk for the settlers even in the southern parts of the prairies, was largely overcome by the introduction of earlier ripening varieties of cereals and garden crops. Early Red Fife, later followed by Marquis, gave security never before possible in production in these earlier times.

High winds caused severe soil drifting in parts of Manitoba which had been worked for a number of years, as reported by Mr. Bedford, Superintendent of the Experimental Farm at Brandon, as early as 1890. Yet compared with the huge area later opened for settlement, the soil drifting area seemed of small consequence. It is little wonder then that the settlers felt assured of crops on this new, free, virgin soil. They saw the tide of settlement following the trails westward, bringing into the country settlers from Eastern Canada, United States, and Europe, many of whom were experienced farmers in home lands where soil and climate were entirely different.

Neither federal nor provincial Governments at that time had sufficient information based on careful soil and meteorological surveys to properly lay down a long-time plan of agriculture. It is probable that only through the experience of settlement could this or any other country acquire the information which we now have.

Soils classification in these earlier days was undeveloped on its present scientific basis. Even those lighter soils when settled would have been classified as good and safe farm land because of their bountiful supply of surface humus. In fact many of these lighter soils, now definitely classified as sub-marginal, produced tremendous crops when still containing their rich supply of humus and in years of good precipitation such as 1928.

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As is well known, the relatively high grain prices during and following the war continued to stimulate expansion of settlement and increased the crop acreage.

Problems which had shown indication in the occasional previous drought year became appallingly apparent in the series of drought years. The tendency was to more highly mechanize and cover a still greater acreage in order to maintain farm revenues. Yields became rapidly lowered in many districts due to the severe and protracted drought. Ravages of insects eliminated what fibre might have been returned to the soil in the shape of stubble or weed growth. Grain farmers still persisted in the practice of burning straw piles and stubble.

The situation became rapidly worse as one crop failure followed another and the area affected became progressively larger. Finally it was recognized that the problem was beyond the competence of municipal or provincial authorities and in 1935 the Dominion Government passed the Prairie Farm Rehabilitation Act, a measure designed to provide for the rehabilitation of drought and soil-drifting areas in the provinces of Manitoba, Saskatchewan and Alberta. Substantial sums were appropriated to be used for assistance on a self-help basis to individual farmers. Conservation of surface water supplies, regrassing of drifted areas, tree planting and assistance in controlling soil drifting by means of cultural treatment were all parts of the program.

DOMINION EXPERIMENTAL FARMS AND THE P.F.R.A. PROGRAM

It was the long-time program of investigational work on the Experimental Farms in the drought area which largely contributed information of fundamental importance and on which much of the P.F.R.A. program was built. From their inception in the year 1886, Experimental Farms undertook experimental work with soils, cultural methods, varieties of crops, and breeds of live stock which might best serve the recently settled or unsettled areas of Western Canada. New Experimental Farms were established at a later date in areas that showed peculiar problems and these undertook an even more extensive and exhaustive study of crop introductions, rotational and cultural studies, and other factors influencing a future farm program. As this work was extended and much more scientific studies undertaken, a laboratory was established at the Experimental Station, Swift Current, Sask., in which the late Sidney Barnes made marked contributions to the knowledge of the behaviour of various crops under different soil and moisture conditions, the moisture requirements of various crops, loss of moisture through crops or evaporation and other equally important information.

Soil Surveys:

Soil surveys and classification in Western Canada were established by the Soils Departments of the Universities. Observations made by the Experimental Farms officers in drought years and on certain soil types as far back as 1914 showed the great need for an accurate classification of western soils in order that results of experimental work might be properly applied to the different soils. For this reason, the Experimental Farms have co-operated in assisting Soils Departments of Universities in completing soils surveys.

Based on these surveys there were established further Illustration Stations and co-operative farmers' tests, of which latter there are thousands, in order to adequately test varieties of crops and cultural methods on the different soil types.

Under the P.F.R. Act, it was deemed wise to materially enlarge the work on certain Illustration Stations and to establish still further numbers to cover the different soils types. These now constitute the District Experiment Sub-stations, of which there are 52 in the drought area.

Soil Research:

Still further fundamental information was needed in order to properly combat soil drifting and other problems. In consequence, a much enlarged soils research laboratory was established at Swift Current, while both the survey and research work in soils in the three Universities was materially stimulated with financial aid.

Fertilizers:

The use of fertilizers as an aid in combating drought is a factor worthy of consideration. As far back as 1900 commercial fertilizer studies were well established on Experimental Farms and with varying results depending on the type of soil and annual precipitation. Later studies were made as to methods of applying fertilizers. The improved methods corrected many of the inconsistencies that had appeared in the earlier experimental results. A joint and large scale experiment to study the use of phosphate fertilizers throughout the Prairie Provinces was established by Consolidated Smelters, the Provincial Departments, the Universities, and Experimental Farms. These carefully selected trial plots were operated for a period of three years and showed in certain districts the amazing value of a small amount of fertilizer.

Implement Studies:

During the last 25 years Experimental Farms have attempted to carefully study all new types of farm machinery which were on the market and might be of economic value to the commercial producer. Later on this grew to the proportions of considerable investigational work, particularly at the Experimental Station at Swift Current. New uses for standard machines, suggested changes in machinery, and the devising of entirely new machines, have gone far toward lessening production costs and providing information as to the effects of various machines in the handling of both soil and crop.

Weed Control:

Weed control is obviously one of the most important reasons for summer-fallow, yet the very methods which were commonly used for the killing of weeds simultaneously pulverized the soil and otherwise stimulated soil drifting. For this reason a special Weed Sub-station was established at Regina to secure information as to the methods best suited to eradicate or at least control the worst weeds. Later the additional factor of retaining a trash cover and a lumpy surface in the handling of summer-fallow or land to be seeded gave information of outstanding worth when the Experimental Farms were called upon to assist in planning a cultural program for soil drifting control.

Plant Breeding:

Meanwhile the plant breeders on Experimental Farms and at the Universities have undertaken a most extensive, courageous and ambitious

program. In wheat production this program was no doubt greatly stimulated by the absolute necessity for creating a high-quality rust-resistant wheat. Plant pathologists and cereal breeders worked together in discovering the various new forms of plant diseases, the susceptibility of existing varieties thereto, and in laying out a program of plant breeding leading toward a solution of these problems. New hybrid wheats, oats, and other cereals with marked resistance to the worst of the plant diseases, as well as to drought and insect pests, are being continuously evolved and thoroughly tested. Earliness and quality with high yield and adaptability to different soil types are still, of course, major factors in the plant breeding program as they were in the earlier days.

Meanwhile forage crop work received its proper recognition as a major field of experimental activity. The discovery of western rye grass and the introduction of many new dryland species of grasses, including brome grass, were earlier accomplishments of great value. Later the introduction of crested wheat grass with its adaptability to very dry land conditions was a still further step forward in providing a species of grass of outstanding worth to the drier sections of the Prairie Provinces. The multiplying of this and getting it well established in commercial production was under way at the time of the passing of the P.F.R. Act.

A still further accomplishment was the creation and multiplying of a non-creeping type of brome grass.

A corn breeding program, especially for southern Manitoba and Saskatchewan, produced early and high yielding hybrids and varieties. In the driest years this crop provides protection in summer against soil drifting, while the high stubble is of equal value in winter toward preventing snow and soil drifting.

Homes and Horticulture:

In the final analysis the permanency of western agriculture will depend essentially on a program of developing permanent rural homes, and because of the high wind, and consequent high evaporation of soil moisture, even without soil drifting, trees become indispensable. In the earlier days of the Experimental Farms, the introduction of new and drought-resistant types of trees and shrubs was part of the regular program of work. These were tested at various Branch Farms and their value rapidly established. Large scale propagation of trees for prairie planting was undertaken by the Dominion Department of the Interior. Two nursery stations were established, at Indian Head and Sutherland, Sask. In the year 1932 these Stations became units of the Dominion Experimental Farms. The access to free trees and shrubs and advice as to the methods of building shelterbelts, which have been given freely to farmers through the three Prairie Provinces, has been of inestimable value. Some 200,000,000 trees have been thus distributed and under the P.F.R.A. program this work is being still further enlarged.

Shelters for homes, thus provided, allow with a great deal of security the protection of first class gardens. For over 45 years Experimental Farms have been carrying on an intensive breeding program toward obtaining hardy tree and bush fruits and early maturing vegetables. Marked progress was made and the products were made available to farmers both through the Experimental Farms and through the nursery and seed trade.

Twenty years ago this work was expanded to the establishment of a special Horticultural Station at Morden, Man. At a still later date the Experimental Station at Rosthern, Sask., expanded horticultural work along these lines.

Irrigation:

The practice of irrigation in crop production on the prairies although comparatively old, has been little followed excepting in a few irrigation districts in southern Alberta. There earlier experimental work was necessary in order to determine the proper principles and practices for the utilization of water in irrigation of various crops. This basic information is now generally used by all those who under the P.F.R.A. program have impounded water for use in crop production, including use by pumping from dugouts or dams or through gravity systems.

These are but examples of results of earlier experiments which are now part of the basic information being built into a land utilization program.

Soil Drifting and Weed Control:

Elsewhere in this issue the problems of soil drifting and weed control will be dealt with more exhaustively. Hence reference here made is solely to point out that experimental data established the basis for present practices. Soil drifting became a menace in Saskatchewan and Alberta over 20 years ago. More by accident than by research the discovery was made that strip farming had a marked influence in curbing soil drifting, yet still allowed the summer-fallow to be used in moisture conservation and weed eradication. This discovery at Monarch, Alta., gradually became known in other districts in that province, and soil drifting was definitely controlled up to the year 1934. Previous to that date, however, farmers in the Shaunavon, Gull Lake, and other districts in Saskatchewan, faced similar severe problems in soil erosion. It was only by the adoption of the same practices found at Monarch that any reasonable control was established. However, in the application of strip farming to soil drifting certain limitations became apparent. A close study of cultural methods through the research work under the late Mr. S. Barnes and the careful observation of experimenters and practical farmers established the necessity of coupling with strip farming cultural measures which would at all times leave the lumpiest possible surface and at the same time retain near the surface all trash which could be used to mechanically hold the soil together.

A study of cover crops to prevent winter and spring drifting quickly showed the usefulness of this practice, the limitation, however, being insect damage to the cover crop itself.

Tree planting had been widely advocated to prevent soil drifting in various agricultural areas and some farmers had established advantageously shelterbelts around fair sized fields throughout their farm. It was considered desirable that this should be tried out on an extensive scale and this work is being done under P.F.R.A.

Implement companies, practical farmers and officers of the Mechanics Departments of Universities and Experimental Farms deserve credit for the evolution in the types and use of various machines in tillage work. The use of the enlarged rod weeders, the development of the Noble blade cultivator, the use in emergency soil drifting control of various types of listers, all contributed toward meet-

ing emergencies and these machines now are in general use wherever emergencies may threaten.

Above all the P.F.R.A. has enabled provincial and federal employees to carry on types of extension work which have caused the greater adoption of experimental data in cultural and other farm practices. Large-scale demonstrations on District Experiment Sub-stations became useful and popular. Extensive investigational work on reclamation stations, grass seeding demonstration stations, and soil drifting control demonstrations, all are of such proportions that farmers watch developments closely and adopt results as quickly as possible. Where community problems of an emergency nature exist farmers with comparatively little financial assistance quickly form for joint action what are termed "Agricultural Improvement Associations". The united effort of farmers in thus solving their soil and crop problems is an example to the farmers of all Canada as to the benefits of co-operative work.

Plans for Land Utilization:

The three Provincial Governments and the federal Government have taken active steps in recent years toward developing land utilization plans based on the economic condition of the farmers and settlers as well as soil surveys, economic surveys and other means of evaluating the carrying power of the land. Special provincial acts which have gradually taken out of general farming submarginal lands which must revert to range or pasture use are rapidly establishing a definite plan of agriculture for these areas. Located in the vicinity of large and smaller submarginal lands are areas of good soil which are adapted to grain and mixed farming but with a distinct relationship to adjacent sub-marginal areas. A type of live stock and grain farming suitable to these areas must be defined and adopted. Methods to prevent further deterioration of range lands due to over-grazing, especially in drought years, and methods for improving range lands must also be generally adopted. Related thereto is the better use of good farm lands which with the aid of local irrigation would guarantee feed supplies in drought years and provide feed for a limited amount of finishing on the ranges or in winter quarters in years of normal precipitation.

The vast tracts of good farm lands need the permanent adoption of cultural practices which will control weeds, conserve moisture, and prevent soil drifting. The adoption by communities of present known practices may guarantee these results and reasonable crops of such grains, grasses, and forages as market conditions may determine.

The rapid increase in the numbers of Agricultural Improvement Associations, the development of community pastures toward absorbing sub-marginal land in good farming areas, and the development of smaller and larger irrigation projects, all actively going forward under P.F.R.A., point toward a proper land utilization policy. The general adoption of the best scientific and practical knowledge in such a policy demands the greatest activity on the part of leading farmers, experimenters, teachers, and extension workers.

Soil Surveys and Soil Research

by

A. LEAHEY*

Soils Research Laboratory, Dominion Experimental Station, Swift Current, Sask.

A SYSTEMATIC STUDY of the soils in the drought area of the Prairie Provinces by means of soil surveys and laboratory soil research has been one of the integral parts of the P.F.R.A. program since its inception in 1935. At that time it was recognized that the gathering and use of information regarding the nature, location and extent of the many different types of soils occurring in the large area under the Act, was of vital importance to the success of a rehabilitation program that was so largely concerned with the land. While soil classification and soil research had been actively carried on by the University Departments of Soils and the Dominion Experimental Farms before 1935, the basic information regarding the widely varying soil conditions occurring in the drought area was far from complete. While the same statement still holds true, although to a lesser extent, the soil investigational work carried on by the P.F.R.A. has added greatly to the knowledge of these soils.

Soil Surveys

The object of soil surveys is to classify the different soils according to their characteristics, to show their distribution on maps and to describe their characteristics, particularly in reference to the growth of crops or the native vegetation. The soil survey reports and maps thus serve as an inventory of our soil resources and as a basis for study of those problems of agriculture which are related to the soil. The ultimate purpose of soil surveying, therefore, is to provide the basic information necessary for sound programs of rural land use and for the classification, interpretation and extension of data regarding agricultural production.

The classification and mapping of the soils in the Prairie Provinces was first commenced in 1921 but large areas still remained to be surveyed in the drought area when the economic depression in the early part of the present decade forced the suspension of this work. With the passing of the Act in 1935, funds were made available for the resumption and continuation of this work on a considerably larger scale than hitherto had been possible. Since that time rapid progress has been made toward the completion of a reconnaissance soil survey of the great area of land, some 140,000 square miles, that comes under the P.F.R.A. In addition, detailed surveys have been conducted on numerous parcels of land intended for irrigation purposes and detailed reconnaissance surveys have been made of several large blocks of land where special problems in land use were encountered.

These soil surveys have been jointly conducted by the Departments of Soils at each of the three provincial Universities and the Dominion Experimental Farms. The University Departments are in direct charge of the work in their respective provinces and provide the necessary facilities for laboratory and office work while the Dominion Experimental Farms through the P.F.R.A. employ the soil surveyors and defray their field expenses. Some funds are also granted

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for such costs as laboratory and office supplies used in connection with the surveys and for the publication of the soil maps and reports.

The Soils Committee under the Experimental Farms Service, comprised of provincial and federal men engaged in soils surveys, co-ordinates the work of the three Universities to ensure a maximum of efficiency, uniform interpretation and application of findings.

This co-operative arrangement between the provincial and federal authorities for soil survey work has proved very satisfactory in that it ensures the utilization of all the available trained men and the existing facilities for conducting such work to the best advantage with a complete avoidance of any duplication of effort.

The following summary shows the progress of soil surveying in each of the three Prairie Provinces. Mention is made not only of the extent and nature of soil surveying since the Act came into force but also of the amount of land surveyed in the drought area before that time. The progress of soil surveying in this area is also shown in the accompanying sketch map.

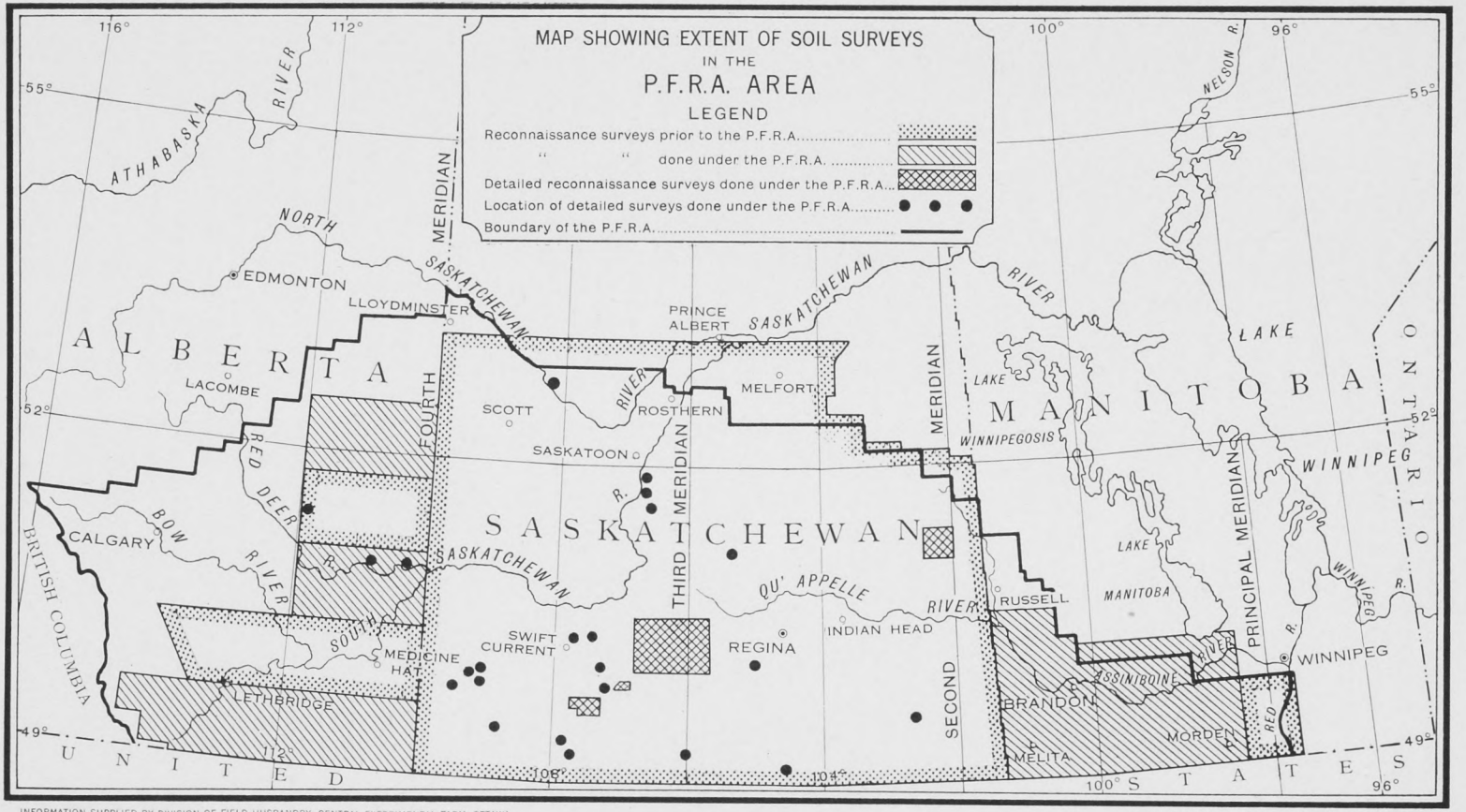
Manitoba. Most of the lands under the P.F.R.A. in this province have been covered by a reconnaissance soil survey during the past few years, there being only some 50-odd townships in the Red river valley surveyed previous to 1935. Altogether, by the completion of the 1939 field season some 11 million acres will have been surveyed. The surveyed area comprises a solid block in the southwestern part of the province.

Saskatchewan. The reconnaissance soil survey of the southern third of this province, in all about 64 million acres, had been practically completed before the advent of the P.F.R.A. Since all the lands under the Act lay within this area, the efforts of the soil survey parties have been devoted to the more detailed surveying of lands which required closer examination than it was possible to give them during the course of the reconnaissance survey.

During the course of this work the lands coming under irrigation projects have received particular attention. Detailed soil surveys have been made on some 20 of the major projects, comprising a total of 115,000 acres. Since these projects vary in size from several hundred to thousands of acres, only their location and not their extent can be shown on the accompanying small-scale map. In addition to these detailed surveys of irrigation lands, detailed reconnaissance surveys have been conducted on 1½ million acres of land where special problems in land use were encountered.

Alberta. While soil surveying had been actively carried on in this province between 1921 and 1931 only about one-quarter of the drought area had been covered since most of the surveying had been done in the park and bush country of central and northern Alberta. However, since 1935 rapid progress has been made towards the completion of the soil classification of the drought area in this province. Some 12 million acres have been mapped by means of a reconnaissance survey in recent years and this amount together with the 6½ million acres previously surveyed means that about two thirds of the area in Alberta under the Act now has been covered by the soil survey.

Three kinds of soil surveys, the reconnaissance, the detailed reconnais-



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DRAWN AT THE OFFICE OF THE SURVEYOR GENERAL, OTTAWA

sance and the detailed, have been mentioned in the above summary. The difference between these surveys lies in the degree of detail used in mapping the soils. This is determined by the nature of the land, its probable use, and the time available for the work. In the reconnaissance survey, the boundaries between soil types are established from observations made along the road allowances which are one mile apart. The detailed reconnaissance survey differs from this in that the traverses are made not only along the road allowances but also in the fields at quarter to half-mile intervals. In the detailed survey, the soils are examined throughout the field at close intervals and the soil boundaries are established from observations made along their course. Which of these kinds of surveying is to be followed in any given area depends upon the objectives at the time the survey is commenced. Since the fundamental purpose of soil surveying is to serve practical objectives the same detail in the differentiation of soil types is not required for all objectives.

Soil Research

The need for study of a number of problems affecting the soils in the drought area, has led to an active program of soil research under the P.F.R.A. which has for its objective, the determination of the fundamental principles underlying soil moisture conservation, soil drifting control and the maintenance and improvement of soil fertility. This research work is conducted chiefly at the Soil Research Laboratory, Dominion Experimental Station, Swift Current, Sask., but in addition aid has been given to the three Universities at Winnipeg, Saskatoon and Edmonton in order that all available facilities might be used in a general attack on soil research problems.

Since all this soil research work is under the general supervision of the Dominion Experimental Farms Service, close co-operation prevails between the various laboratories and the Dominion Experimental Stations in Western Canada for attacking those problems that require the joint efforts of field and laboratory investigations for their solution.

Soil Research Laboratory—Swift Current

This modern and well equipped laboratory was established by the P.F.R.A. for the purpose of continuing and expanding the soil research work previously conducted at Swift Current by the late Mr. Barnes who in his investigations on soil moisture clearly showed the value and need for fundamental research on soil problems affecting dryland agriculture. While the solution of these problems requires long and painstaking effort, the results obtained since the establishment of the laboratory show that definite progress has been made toward the solution of the more pressing problems. No general report on the entire field of work covered by the laboratory has yet been published but several papers on certain phases of the investigations under way have appeared in scientific journals.

Many problems relating to soil fertility, soil moisture, and soil drifting are being investigated at the Soil Research Laboratory. An enumeration of some of the chief problems under study will show the nature and scope of the work being done.

(Continued on page 91)

Economic Research in the Drought Area in Western Canada

by

J. Coke*

Economic research initiated under the Prairie Farm Rehabilitation program centres around the problems of land utilization with present emphasis on land classification, although steps are now being taken to enquire into the problems of farm and ranch re-organisation.

Just prior to the passage of the first Prairie Farm Rehabilitation Act in 1935, research in farm indebtedness had been carried on by the Department of Farm Management of the University of Saskatchewan but with the continuation of drought years, it became evident that an effort should be made to set up a basis for adjustments which might be deemed necessary.

No effort will be made in this short article to deal with the development of the problems[1] arising from the recurrence of drought years in the provinces of Saskatchewan and Alberta. It should, however, be observed that in Saskatchewan a Land Utilization Board had been set up and in Alberta a Special Areas Board had been established to cope with problems arising from shifts in population resulting from errors in the selection of land during the period of settlement.

In 1935, therefore, it was but natural that these agencies should be consulted with respect to the sort of economic research required. Advisory committees were set up in both provinces to work in co-operation with the research agencies, namely, the Economics Division of the Dominion Department of Agriculture, the Department of Farm Management, University of Saskatchewan and the Department of Political Economy, University of Alberta. In Saskatchewan, an area comprising seven municipalities including and surrounding such places as Gravelbourg, Coderre and Wood Mountain were selected for the initial study and this area has since been widened in all directions to include 34 municipalities and four improvement districts representing 7,594,271 acres. The land in this area has been classified on a basis of economic productivity.

In Alberta, the initial study was carried on in the Vulcan-Lomond area and by the spring of 1939, a land classification had been set up for the six special areas, Sounding Creek, Sullivan Lake, Neutral Hills, Berry Creek, Tilley East and Bow West[2] representing an area comparable to that completed in Saskatchewan. Only two reports[3] have been printed but others have been prepared for official use.

The land utilization concept is based upon the principle that land varies in productivity and that it should be used in such a manner as to provide for the conservation of all resources. The research projects ini-

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[1]See "An Economic Study of Land Utilization in Southern Alberta," G. H. Craig and J. Coke, Technical Bulletin 16, Dominion Department of Agriculture.

[2]These special areas have since been consolidated.

[3]"An Economic Study of Land Utilization in Southern Alberta," publication 610, Technical Bulletin 16, G. H. Craig and J. Coke, Dominion Department of Agriculture. "Physical and Economic Factors Related to Land Use Classification in Southwest Central Saskatchewan," publication 609, Technical Bulletin No. 15, Dominion Department of Agriculture.

tiated in these two provinces have to do only with agricultural land and in the main, farm population, but obviously, the nearby village and town populations are also affected. Some agricultural land will not support farm families at a reasonable level of living on the basis of past or present use nor will it support the public services necessary for a permanent agriculture and a prosperous rural community. Therefore in the development of public policy, it becomes necessary to make a careful appraisal of agricultural land resources. The economic research which has been initiated represents an effort to provide, in part at least, a basis for this public policy. From the standpoint of the farmer, it should assist him in making adjustments necessary to provide a reasonable level of living. One need only consider the recurrence of low yields of wheat and other crops in recent years, mounting indebtedness of many farmers, and the status of municipal and provincial finances to realize that re-adjustments are necessary.

In carrying out the classification of land, suitability for wheat production has been the basis. Soil, topography, stoniness, yields of wheat over the 16-year period 1921-36, arable acreage, farm and family budgets have been the criteria used in determining productivity. Supporting data, such as condition of buildings, abandonment, tax delinquency, indebtedness and relief payments have been obtained.

In Saskatchewan, five land classes have been set up in the 38 municipal units completed. Land Class 1 embraces the land upon which less than 350 bushels of wheat per quarter section are potentially available for sale. Land Class II contains land upon which from 351 to 450 bushels per quarter section are available for sale. Land Class III is land upon which from 476 to 720 bushels per quarter section are available for sale. Land Class IV is land upon which from 721 bushels to 900 bushels are available for sale. Land Class V contains the land upon which over 900 bushels are potentially available for sale.

In Alberta, slightly higher production per quarter was necessary in order to allow for transportation charges and thus far because of the nature of the area surveyed, only four land classes have been established in that province.

In explanation of the land classes established in the Saskatchewan area, it may be said that land Class I is considered to be sub-marginal for wheat production because it produces less than 350 bushels of wheat for sale. It is land that has an alternative use as grazing land.

Land Class II is rated marginal for wheat production. It is so classified because it has been discovered from farm management research conducted in this and an adjacent area that on a three-quarter section farm, annual sales of about 350 bushels of wheat per quarter are required to provide wages for the operator and to meet cash farm expenditures and depreciation on machinery and buildings. Such a rate of production will not, however, contribute anything toward the payment of interest charges or yield any profit. It should be noted, too, that wages for the operator are only equivalent to those paid to year hands. Farm budgets for this size of farm indicate that a farmer, his wife and four small children can have only a fair level of living from an annual sale of 475 bushels of wheat and minor sources of income, which is the upper

limit of production in the marginal land class. These two land classes are of importance because they determine the margin of wheat production. It is unnecessary to refer further to the higher land classes but the distribution of land in the Saskatchewan area by land classes will be of interest.

Land Class I—Consists of parcels "sub-marginal for wheat production." The soil—sand to sandy loam, gravelly, alkali, or "blow-out" loams, is inferior, though the topography and other physical features may be favourable for cultivation. Where the soil is more superior—loam clay loams —the surface (decidedly rolling, hilly and rough and with frequent occurrence of stones) makes the land unsuitable for cultivation. With some parcels soil texture is the limiting factor, with others, it is the amount of land which can be cultivated, while with others, it is a combination of both these disadvantages.

Land Class II—Consists of parcels "marginal for wheat production." The soils—fine sandy loams, light loams, and blow-out loams are less affected by blow-outs and in general less inferior than blow-out loams in Class I, though the topography and other physical features may be favourable for cultivation. Where the soil is more superior—loams, clay loams, the topography is quite rolling, quite stony or with parts of the quarter-section non-arable from other causes. As with Class I land, soil texture is the limiting factor with some parcels, with others, the amount of land cultivable, and with still others, both the amount cultivable and the soil texture.

Land Class III—Consists of parcels described as "fair for wheat production." Where the soils are loam, the topography varies from level to moderately rolling while with soil of heavier texture—clay loams, the topography is rolling and stones occur frequently enough to substantially add to the cost of cultivation. Sloughs, potholes or ravines commonly cut down the amount cultivable per quarter.

Land Class IV—Consists of parcels described as "good for wheat pro-

TABLE 1. SUMMARY OF LAND CLASSES ESTABLISHED IN THIRTY-EIGHT MUNICIPALITIES IN SOUTHWEST CENTRAL SASKATCHEWAN, 1935-38.

	Land Class				
	I	II	III	IV	V
Percentage of total area	38.2	18.7	28.9	12.1	2.1
Potential annual production of wheat for sale on an average per quarter section (approximate range in bushels)	Less than 350	351–475	476–720	721–900	Over 900
Broken or improved, per cent	19.3	64.5	85.9	96.8	98.7
Vacant and/or abandoned, per cent	22	10	3	1	—
Occupied land held under grazing lease, per cent	40	2	—	—	—
Owned by private individuals, per cent	49.3	88.6	92.8	95.6	96.8
Publicly owned, per cent	42.5	3.8	1.3	0.6	—
Occupied farms predominately within, per cent	15.3	21.7	41.9	18.2	2.9
Occupied farms wholly within, per cent	9.9	9.6	21.0	10.0	1.4
Tax indebtedness before adjustment in per cent of assessed value for twenty-seven rural municipalities surveyed in 1937-1938 (Excludes all land with nominal assessment for grazing lease purpose.)	12.1	11.1	9.2	7.0	3.2

TABLE 2. PROPORTION OF AREA IN EACH LAND CLASS, NEUTRAL HILLS SPECIAL AREA, ALBERTA, 1937.

Land Class	Number of parcels	Per cent of total	Total acreage
I.	4,063	55.3	650,080
II.	1,745	23.8	289,200
III.	1,142	15.5	182,720
IV.	394	5.4	63,040
Total area	7,344	100.0	1,185,040

duction." The soil varies from a clay loam to clay. Topography is level to undulating with very few stones. Only the occasional slough hinders the total cultivation of a parcel. While this description applies generally to the physical factors of the land in Class IV, there are similar parcels which are rated in Land Class III. Such parcels occur in areas where the liability from hail damage is high and also in areas where the crop histories indicate more than "usual" drought occurrence.

Land Class V—Consists of parcels described as "excellent for wheat production." The soil is generally of a heavy clay texture, topography is level to gently undulating but well drained and stones seldom occur. Practically a full parcel in this land class is cultivable. While this description applies generally to the physical factors of the land in Class V, there are like parcels which have been rated in Land Class IV. Such parcels occur in areas where the liability from hail damage is relatively high.[1]

A table comparable in all respects for the whole area surveyed in Alberta is not available but the distribution by land classes in the Neutral Hills Special Area is informative—55 per cent being placed in Class I—that is sub-marginal for wheat production. In the Sullivan Lake Special Area, 69 per cent was placed in Land Class 1.[2]

It is not claimed that any of these areas are typical of the agricultural land in Saskatchewan or Alberta. It must be remembered that in conducting these projects, the problem areas were selected and, therefore, when the classification is completed for larger areas, it is reasonable to expect that a smaller percentage would come within Class I. The data presented, however, show the wide variation and emphasize the usefulness of such an appraisal of agricultural land resources.

Two other projects have been inaugurated in 1939. The first is the study of ranching in Saskatchewan and Alberta. This study is expected to provide information on the business organization of ranches in Western Canada and the data thus secured will be helpful in suggesting ranch reorganization which could reasonably be expected to increase ranch incomes.

The second study is under way in Saskatchewan and has to do with landlord and tenant relations, leasing systems and the equitableness of present-day leases. The growing importance of farm tenancy has made it necessary to make a careful study of this problem. (Continued on page 22)

[1]Unpublished data prepared by C. C. Spence.

[2]Unpublished data prepared by J. Proskie and A. Stewart.

Land Utilization in Alberta

By O. S. Longman*

The enactment of the Special Areas Act in 1927 by the province of Alberta probably represents Alberta's official endeavour to cope with the drought and land utilization problem.

This Act was based upon the report made by the Commission appointed on February 20, 1926, affecting the welfare of that portion of the province now known as the Tilley East Area. The Commission, according to its terms of reference was instructed to,— "cause enquiry to be made into all the conditions presently prevailing in the following district, namely: that part of the province of Alberta lying to the south of the Red Deer river, to the east of the line between Range 10 and Range 11, west of the Fourth P.M., to the west of the easterly boundary of the province and to the north of the South Saskatchewan river; and, without limiting the generality of the foregoing, to enquire into the population now residing therein, and the lands occupied by such residents in the said district; the value of such land and the amounts of mortgages and other charges against the same; the lands in the said district owned by private persons, and the amount of the mortgages and charges against any such land; the financial standing of all municipalities, villages and school districts within the said district; the nature of the land in the said district, and the use to which the same may be most profitably put; and the measures necessary to bring the said land into such profitable use."

The proposals of this Commission, after having made full enquiry, are embodied in the following summary of recommendations, namely,—

1. That this be declared a closed area and that no further lands be alienated from the Crown.

2. That parliamentary and legislative authority be secured to enable the properly constituted authorities to make compromise settlement of arrears of taxes, seed grain and relief liens and any other Crown claims now levied against the lands or to cancel in their entirety any such Crown claims if found necessary.

3. That a Board be appointed to administer the lands within the area, with representation thereon of Dominion and provincial interests, such Board to consist of not less than three and not more than five members.

4. That the powers of the Board be sufficiently general to meet all requirements and to include the following:

(a) To make general regulations for the administration of said lands, such regulations to become effective upon approval by Order in Council.

(b) To define lease areas, fix terms for leases and rentals payable thereon, having in view the use for which such lands might be utilized, and to provide that such rental be an inclusive one to cover all taxes and charges which may be levied against such lands, in addition to the return to the Crown for the rental of said lands.

(c) To adjust and vary the leases already granted, whenever possible, so as to provide for the distribution of the water supply to the best advantage.

(d) To decide upon the amount of the debenture liability, if any, now

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outstanding, which shall be carried as a specific charge against any school district and to negotiate with the debenture holders so as to arrive at an adjustment of all the debenture lability now payable by the rural and village school districts.

(e) To arrange for the removal of settlers to new locations within the area.

(f) To lease lands to the present residents of the area, such residents to be given the first refusal of reasonable acreage now occupied by them or which is adjacent to their present holdings.

(g) To set aside any area for community grazing if deemed advisable.

(h) To segregate any section within the area from the general provisions relating to the closed area.

(i) To deal with all questions of policy relating to such lands.

5. That authority be given to a properly constituted authority to order an exchange of land with any owner or other interested party, such exchange to be on a valuation basis, and to lands within any portion of the area which may be set aside for that purpose, or to other Crown lands, in the right of the Dominion or of the province, outside the area, if considered advisable, so as to bring the Crown lands into solid parcels. (In making this recommendation, it is not suggested that any consideration be given to encumbrances or charges now registered or levied against these lands, but only to the actual value of the lands, if unencumbered, it being understood that the holders of such encumbrances or charges must be prepared to accept the loss which has been sustained through the fact that the lands are not adapted to the use to which they were put when the advances now forming such encumbrances were made, and that the desire is to so consolidate the holdings that the private interests will be able to secure some returns from the land in which they are interested which, under present conditions, is practically impossible, as well as to enable the Crown to deal with other parcels by providing for the closing of road allowances wherever necessary.)

6. That authority be given to the proper officials by parliamentary action, if necessary, whereby the vacant school lands within the area can be exchanged, on a valuation basis, for other Crown lands outside the area, so that all lands within the area will be consolidated into one block and be subject to one control only.

7. That first consideration in the allotment of lands be given to the present residents of the area who desire to remain.

8. That every possible assistance be given to the residents in adjusting their existing liabilities, and that it be a condition of entering into an agreement to secure further lands in the area, that the old liabilities have been adjusted.

9. That proceedings be taken against all lands in arrears for taxes, whether occupied or abandoned, so as to secure title thereto in the name of the Crown, and that the Board be consulted in fixing the terms of the redemption of the upset price for said lands.

10. That arrangements be made in cases where proceedings are taken by taxing authorities, under The Tax Recovery Act, whereby the passing of title to any parcel of land to the taxing authority will have the effect of disposing of all liens, Dominion and provincial, which may be regis-

tered against such parcel of land, so that the taxing authority will secure clear title thereto.

11. That the existing rural municipalities be disorganized as soon as possible and that control be exercised in securing title to lands in arrears for taxes in such districts.

12. That the basis of valuation of land for assessment purposes be revised, so that the assessment will be reduced to the approximate valuation, having in view the use to which such lands can be put.

13. That school districts not in operation be disorganized and that the remaining districts be reorganized to meet the actual needs of the community.

14. That the debenture indebtedness now chargeable against the school districts, or so much thereof as may be decided by the Board as being chargeable to the area at large, be placed against the lands within the area and be retired out of the proceeds from rentals of lands within such area.

15. That arrangements be made for the closing of all road allowances on any grazing leases which may be granted, and for the opening of any necessary trunk roads to meet the needs of the community.

16. That steps be taken to cancel the interest of the Canada Land & Irrigation Company to all lands controlled by it within the area so that such lands will revert to the Crown and that all outstanding agreements for sale, pre-emptions and purchased homestead agreements in arrears be cancelled.

17. That the necessary arrangements be made for conservation of water and supplying water wherever possible, under the supervision of the Reclamation Branch of the Department of the Interior.

18. That authority be given for the continuation of any experimental work now under way and for the extension of same, so as to discover the fodders, grasses, etc., best adapted to the area.

19. That all applications for leases be received by the present officials of the Dominion Land Department,[1] but that such applications be referred to the Board to be passed upon before any allotment is made.

20. That the officials of the Dominion Land Department as far as expedient, be responsible for the administration of all leased lands, subject to the supervision of the Board, including the collection of the inclusive charges levied against the same, such charges to be collected in advance.

21. That any applications for leases now pending with the Dominion Land Department be passed upon by the Board, and that temporary leases only be granted pending the consolidation of the parcels to be used for lease purposes.

22. That any leases granted and any agreements entered into with the residents of the area be non-assignable except with the approval and consent of the Board."

The Special Areas Act was designed and is intended to mend in a measure the mistakes of a land settlement policy which had placed thousands of settlers upon lands which were capable of sustaining only a small fraction of their number—the great tragedy of Western Canada.

Without dealing with contributing causes creating the foregoing situation, it may be briefly stated that the basic principles of the Act are as follows:—

[1]Dominion Lands Board, Department of the Interior, Ottawa.

(a) That within reasonably well defined areas soil and climate limitations will not provide human subsistence and economic security from ordinary farming based upon cereal production.

(b) That the recurrence of past experiences be avoided by taking lands out of private control and making them part of the public domain, thereby making further settlement and use of the lands subject to administrative control.

(c) That the population remaining within the Area must be in keeping with its productivity; thus depopulation of the Area to be encouraged to a reasonable degree.

(d) That the method of securing a livelihood within the Areas must be designed to the limitations prevailing within the Areas; limitations of climate, soil, moisture, and the possibilities of social services, etc.

(e) That to bring about the desired adjustment, a single authority be established to effect the necessary adjustments.

Administrative Problems.

In attempting to solve the problems confronting any authority charged with an adjustment growing out of the drought situation, the fundamental nature of the administrative problems should not be overlooked. It has to do with land, its production in the form of crops or forage, the efficient utilization of its production, its management and conservation, the correlation of crop land and range land, the correlation and development of undeveloped resources. All these factors are closely associated with the biological and agricultural sciences, and are therefore part and parcel of the agricultural land problem of the province.

One of the most important duties of the administration is to determine the natural resources of the Areas in question. Among these the more important are:

Water Resources—The lack of water is the basic problem of the drought area. Therefore, the determining of surface water run-off, its quantity, its flow and its most efficient utilization; the determining of subterranean supplies, their character and utilization; the contribution which rivers and streams may make to rehabilitating population, is of prime importance in any program of readjustment.

Soil Resources—During the settlement of the prairies little heed was paid to the varying quality of the soil. Later experiences and investigations have shown a wide variation in quality, in production and in usefulness. It therefore becomes important that soils be classified on a basis of their productivity and used and managed in a manner compatible with their limitations or possibilities of production.

Grass Resource—This natural resource has been largely depleted through over-grazing and mismanagement. Its re-establishment is essential in a very large section of the Areas. Over-grazed prairies must be rehabilitated and land unsuitable for farming needs to be regrassed. This will be a time-consuming process, and will require the constant effort and continual patience of all who are vitally interested in alleviating the situation.

Game Resource—This is a resource which man has delighted to exploit, even to destroy. While the drought area may not be a game-inhabited region, there are possibilities of conserving and enhancing this resource for the benefit and sustenance of those

who live within the area; the possibilities of this resource must not be overlooked.

Human Resource—This is the all-important resource. The extent of human wastage caused by the settlement of the extreme drought areas of Alberta and Western Canada generally, will never be measured. Much of it is hidden and can be recorded only in the form of wrecked hopes and silent despair, the destruction of initiative and self-reliance, the exhaustion of life savings, reduced standards of living and inadequate education. These are some of the fruits and costs of our intent and desire to exploit our great resources without first measuring their limitations. To avoid this wastage and to re-establish this resource gives justification to concerted effort on the part of the Government and all departments of the Government to restore and rehabilitate those who have suffered.

The fundamental purpose of a program such as is contemplated under the Special Areas Act is the betterment of rural social conditions by improving the economic return from the lands within such areas. To this end local associations of stockmen or farmers can make an important contribution to improved rural conditions. However, no permanent improvement can be realized in rural life unless the rural population accepts with pride and appreciation the custody of the land resource. Distress growing out of land abuse cannot be finally removed until the doctrine of land stewardship becomes firmly imbedded in rural thought. The desire to exploit new lands must be replaced by a sense of duty to improve and rehabilitate lands that are already occupied.

Note: The transfer of natural resources to the province has taken place since the Commission, referred to herein, made its report. The Special Areas in the province of Alberta subject to the provisions of the Special Areas Act include approximately 365 townships composed of 50,500 parcels, including approximately 8,800,000 acres of land. This area originally consisted of about 37 Municipal units which had a population of 40,647, which has through Government encouragement been reduced, during the past fifteen years to approximately 29,500, including both rural and urban populations.

ECONOMIC RESEARCH . . .

(Continued from page 17)

The land utilization projects are also being extended in 1939. Farm management data, which are essential to the study of the problems of farm organization, are also being secured. Such studies will provide information which is necessary to the development of budgets which are required when new type-of-farming areas are subject to land classification.

Land Utilization in Saskatchewan

by

E. E. Eisenhauer*

The influx of settlers to Saskatchewan reached enormous proportions in the period 1905 to 1914. Many thousands of people took up land in what was then the last Great West, with little attention being paid to the type of land on which they settled. Homes sprang up, and soon there appeared those boundless fields of golden wheat, for which Saskatchewan became famous. Bountiful crops rewarded the efforts of those who laboured and with the demand for more production many millions of acres which should have been left in native grass were cultivated. The prolonged period of drought extending with varying degrees of severity from 1929 to 1937 emphasized the impossibility of making a living by the arable farming of some of this land. The soil and economic surveys, undertaken when these troubles appeared, together with the practical experience of the early settlers show the necessity of special consideration being given to proper utilization of all land.

During the early years of settlement and cropping of the virgin prairie with its centuries of stored fertility these handicaps were not so apparent. With the coming of years of drought, poor crops, low prices and heavy financial burdens, the less productive soils with somewhat impaired fertility presented a problem that required immediate action. Careful soil surveys and the experience of discouraged settlers living on poor land, resulted in some 16,000,000 acres being classed as unfit for cultivation. Fortunately, of this land which the soil specialists and agricultural economists class as sub-marginal and unsuitable for cultivation, only 4,000,000 acres is being farmed. These studies emphasized the necessity for a program of land utilization and rehabilitation.

Many people living on this inferior land and realizing the impossibility of making a living, moved to areas of more certain crop production in other parts of the province. This movement reached its peak in 1932 and it is estimated that up to date a total of almost 10,000 families from the south have carved for themselves new homes in the wooded area and park belt of Saskatchewan.

A thorough study of the so-called drought area indicated that if the population were thinned out sufficiently and suitable agricultural practices followed it would be possible to improve the status of many thousands of people in the areas in which they are presently located.

In those periods when good crops and prices prevailed there was considerable optimism not only among the farmers but also among the loaning corporations and the business interests. This was illustrated by the extensive credits allowed on these poor lands both for capital expenditures and current expenses. As a result many lands were burdened by mortgage and other encumbrances greatly in excess of the paying ability of the land as judged by its productive capacity. Many millions of this indebtedness have been written off by tax cancellation and voluntary debt adjustment. A still further step in this direction is the revaluation of this land for assessment and taxation purposes as set out in recent provincial legislation. This program extending over a five-year period in the

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drought area should be highly constructive in its relation to taxation. It would seem too that recent Dominion legislation affecting mortgage loans would tend to reduce present indebtedness as well as bring about a lower interest rate on such debt, which certainly is essential to any agricultural land policy. In short, debt adjustment, revaluation of land for taxation purposes and the withdrawal from arable farming of poor land which cannot be profitably operated, are methods being developed for solving the problems of Saskatchewan farmers.

In order that the lands which had been abandoned and lands which should be depopulated might be properly handled, the Land Utilization Act was passed in 1935. This Act provides the necessary machinery to enable governing bodies to get control of sub-marginal land and take it out of cultivation. Such action means the movement of some settlers to other lands of more certain crop production and the necessary adjustment of encumbrances against such land. As a further step to the proper utilization of these lands it is necessary that a program of regrassing abandoned farming areas be carried out so as to make it suitable for grazing purposes.

This is pre-eminently an agricultural problem but many different departments of the government are involved. Hence it was necessary to set up a Land Utilization Board to take active control of this work. Representatives of the Departments of Municipal Affairs, Natural Resources, Local Government Board and the Department of Agriculture, together with representatives from the Soils Department and the Economics Department of the University of Saskatchewan make up this Board. As the main feature of its work is to take out of grain production those areas unsuited for cultivation, this Board is interested in the proper utilization of any area regardless of whether it comprises one quarter section or many quarter sections. When the original holdings of sub-marginal land are taken over by the Crown the settler is assisted to move to a better location. In this way it is assured that the land will never again be cultivated.

If control of enough of these parcels is obtained in a single block to provide a unit in which the Prairie Farm Rehabilitation Branch of the Dominion Government can construct a community pasture, the area is then used for this purpose. However, with the wide variation in soil types in existence in a comparatively short distance such as is found in many parts of Saskatchewan it can be realized that there are many areas which will be too small for the formation of community pastures. In such areas it is possible by means of the Land Utilization Act either to operate these as grazing areas and have them operated by a Municipality or add them to a ranch lease under the supervision of the Department of Natural Resources. In other instances it may be more advantageous for the Land Utilization Board to lease these small parcels for grazing purposes to an individual on an adjoining farm. In this way it is possible to provide an economic unit for the individual and at the same time ensure a better utilization of this problem land.

Due to the encumbrances on these lands and the necessity of providing educational facilities for people remaining in the district, the Land Utilization Board finds that there are

delays in extending its control over such lands. This control is obtained in various ways. In those areas where the lands had been abandoned and there were arrears of taxes, the normal procedure under the provisions of the Arrears of Taxes Act results, in due course, in the title becoming vested in the Board. In other instances where tax sale certificates were in existence, arrangements were made to have the municipalities transfer them to the Land Utilization Board, and titles to a number of parcels were thus obtained. It is interesting to note that this method of procedure has brought almost 1000 quarter sections under the control of the Board and fully another 1000 quarter sections are in course of being obtained. Still another method of obtaining permanent control of sub-marginal land was by means of exchange for Crown or municipal lands of better quality. Many people living on such lands were given an opportunity to exchange their lands and were provided with transportation to their new holdings. Encumbrances on their original holdings were transferred to their new properties.

The movement of settlers from sub-marginal lands with the consequent development of community pastures has presented a serious problem in connection with school districts. While the revenue producing ability of the district may have been deteriorated before pasture development took place, there is the certainty that once the lands come into the permanent possession of the province they cease to produce tax revenue. The debenture indebtedness, the arrears of teachers salary and other operating expenses are therefore questions of the greatest importance when readjustment of such claims is under consideration. The problem of the encroachment upon, or the absorption of school districts by community pastures creates a problem of school administration that has not been completely solved. This question is being studied by the Departments of Education and Agriculture with a view, first, of the adjustment of the debts, and second, providing educational facilities for the people remaining in the district. This may necessitate the enlargement of an existing school district by the addition of portions of the dismembered districts, or it may mean the setting up of entirely new districts, the whole purpose being to create self sustaining units able to provide education facilities on a satisfactory scale for the people remaining in the area. This is a matter requiring very careful and painstaking adjustment before a final solution can be made.

The procedure followed in establishing a community pasture is to have a request from the municipality by way of resolution for such development, outlining the area they wish to have used as a pasture. A district representative from the provincial Department of Agriculture then surveys each quarter section to determine whether it is sub-marginal and if so the Land Utilization Board then proceeds to get control of all lands within the area. As soon as this is completed a request is made to the Prairie Farm Rehabilitation Branch to construct a pasture, to develop water facilities and to do any necessary regrassing to ensure satisfactory use from the pasture. The pasture is then made available to surrounding farmers and in this way provides not only for the proper utilization of the sub-marginal land, but also provides for diversified live stock farming for those settlers. Continued on page 95

Manitoba and Prairie Farm Rehabilitation

by

J. H. Ellis*

This article deals with a few of the provincial or local aspects of the rehabilitation problem as applied to Manitoba.

The area in Manitoba, affected more or less periodically by climatic drought, is that portion of the province in which the regional soils were developed under upland grasses. In addition to the open grasslands, this includes the southern portion of the "prairie and aspen grove" region, where, in favourable seasons, the locally humid (or low position) soils may permit the encroachment of trees, but where, in dry seasons, the invading trees may be killed by drought. In extreme seasons throughout this potential "drought area" in Manitoba, climatic drought may be general; in other seasons, drought may be confined to local districts. Climatic drought in any portion of this area may be of varying severity, of varying duration, and of varying frequency.

The potential drought area coincides geographically with the provincial Crop Reporting Districts 1, 2, 3, 4, 7, 8, 9, and the southern part of 10, but it can be divided into two sub-divisions on the basis of the severity of the drought problem. In the southwestern portion, represented by Crop Reporting Districts 1, 2, and 7, droughts are usually more frequent, more severe, and of longer duration than in the remaining portion of the grassland region. In the southwestern portion, severe periodic droughts alternating irregularly with favourable years can be considered as the normal climate; in the remainder of the grassland region, severe and prolonged droughts may be considered as the sub-normal condition.

The total acreage of the potential drought area in Manitoba is much smaller than that of Saskatchewan or Alberta, nevertheless the local importance of this area is indicated by the fact that it contains one-half of all the land in the provincial crop reporting districts, three-fifths of the total farms, and four-fifths of the cultivated land of the province. The southwestern portion contains one-fifth of the farms and one-third of the cultivated land of the province. Hence, from a provincial standpoint, periods of widespread drought can result in agricultural disaster.

Specific Objectives of Rehabilitation

The specific objectives that must be achieved if habilitation is to be maintained in the drought areas may be summarized as:—

1. Adaptation of land use to soil type.

2. Provision for securing adequate supplies of water for domestic and stock purposes.

3. Provision for subsistance (which includes food for the farm families, feed for the necessary live stock, and reserves of feed and seed).

4. Provision for the control of soil drifting and for the combating of drought on the arable lands.

The rehabilitation activities under the P.F.R.A. in Western Canada are directed towards the above objectives. It must be recognized however, that although the problems arising from the

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occurrence of drought, etc., have much in common throughout the entire area, nevertheless the methods of approach may have to be varied because of the nature, the severity, and the locality of the problems. A few only of the local aspects need be mentioned to emphasize this point.

Local Aspects

Land Use. The establishment of pastures on large blocks of sub-marginal lands, and the regrassing of large acreages for range land in districts which are sub-marginal for arable culture, has become an important activity under P.F.R.A. In Manitoba, there are no large areas of so-called "farm lands" which should be evacuated and retired to grass for range purposes because of drought. Even in the southwestern portion of the province, periods of distress are invariably followed by years or periods favourable for crop production, so that long-time yield records show fair averages. Hence, from a climatic standpoint, it is not necessary to convert large acreages of Manitoba farm lands into community pastures. However, variations in soil type throughout the area are responsible for numerous scattered sub-marginal sections. Where such sub-marginal lands are not cultivated but are used for hay and pasture by the owners (as is often the case) no rehabilitation action is required, but where attempts to farm these sub-marginal parcels result in disaster, their cultivation must be prevented. The seeding down of such lands should be undertaken as a rehabilitation activity. The logical policy of dealing with these areas which are too small for community pasture set-ups, would be for the municipalities concerned to hold these reseeded parcels as municipal hay and pasture lands, under agreement that they be kept out of cultivation.

From the standpoint of soil conservation and permanent rehabilitation on light-textured soils, it is questionable if the easy access to a community pasture may not be detrimental rather than helpful. There are a considerable number of farms (some with medium to light textured surface soils and with moist subsoils) which in the past have been used largely for the production of cereals alternating with fallow, and on which soil conservation practices must be adopted if such farms are to remain arable. In many cases the periodic retirement of portions of these farms to grass, the increase in acreage of sweet clover, the use of corn as a partial substitute for fallow, and other modifications in management required to control soil drifting, would more than provide the feed necessary for the maintenance of the live stock kept. "Home pastures" on many farms would be a better slogan than "community pastures". A policy which permits individuals to exploit their own land by the continuous rotation of grain and fallow to the point where soil drifting becomes chronic, and at the same time permits such individuals to exploit the state grazing reserves, is one which does not rehabilitate. Hence under Manitoba conditions the stress should be placed on soil conservation with the incidental production of feed, rather than on the converting of protected reserves into community pastures.

The need for reserve pastures under government control is admitted; and the province has consistently followed the policy of holding the forest reserves within the drought area as reserve pastures for use in times of emergency.

Water Development. The difficulty of obtaining adequate supplies of water for domestic and farm use is not coincident with, nor confined to the drought area. The wide distribution of this problem, and the success of the water development activities under P.F.R.A., has been largely responsible for repeated demand by certain interests that rehabilitation activities be extended into other areas where water shortage is a serious problem. To meet this situation it may become necessary to provide two alternatives: (1) the continuation of the present assistance policy of water development in designated drought areas; and (2), the installation of an extension policy whereby technical services and leadership (without financial grants) are provided for districts where water development projects are urgently needed, but where financial assistance for their construction is not justified.

With further reference to water development activities it should be stated that the adoption of an organized system of conservation on all water-shed areas would be a worthy contribution to rehabilitation by this province.

Subsistance. The principle of providing subsistance for farm families by the planting of gardens and the keeping of some live stock and poultry is generally recognized by the farmers in Manitoba's drought area. Agricultural statistics for the eight municipalities in the southwestern portion of the province, show that the average live stock kept per farm consists approximately of nine horses, seventeen head of cattle, four sheep, ten pigs, one hundred and nine hens and chickens, and fifteen other poultry. This stock is for the most part of good quality. Moreover, when local crops are favourable, none are more eager to contribute vegetables by the car-load, for the relief of distressed "neighbors" in other parts of the drought area, than are the farmers of southwestern Manitoba. Hence the necessity of providing supplies of food for farm families in southwestern Manitoba, that arose in times of acute drought, was not due to the lack of gardens and live stock, but was due primarily to the failure of the crops. Thus the production of the necessary subsistance in the drought area of Manitoba, largely resolves itself into the problem of ensuring the growth of garden and feed crops. Individual water development schemes of various types can be developed to aid in assuring the production of garden crops in periods of drought, but larger schemes for the irrigation of field crops are out of the question, hence, the production of feed and forage will be governed by the success of the dryland management practices that are used in the combating of drought.

Control of Soil Drifting and the Combating of Drought. There are many local phases of these two objectives that could be outlined. Briefly it may be stated that progress in the control of soil drifting, and in the combating of drought on the arable land throughout the area, depends upon the extent to which each farm operator puts into practice on his own particular holding, the methods that have been shown by experiment and experience to be most effective. This involves education and leadership. Much excellent work has been accomplished in the education of individuals, and in the leadership of groups through various extension activities, but in some districts much remains to be accomplished. Under

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Organization of the P.F.R.A. for Water Conservation and Resettlement

By Geo. Spence[1] and John Vallance[2]

When the Prairie Farm Rehabilitation Act was established in 1935 it was not possible to forecast the extent of the work to be undertaken, nor was it possible to set up an organization to meet all conditions. During the first year water development and the cultural phases of P.F.R.A. were administered by the Dominion Experimental Farms Branch. Practically all the work was in its initial stage and considerable organization was necessary. Outside of water development, both small and large projects, the main problems studied were cultural.

The serious drought of 1937 presented further complex problems. It was necessary to take immediate action in the movement of settlers, more definite agreements on land policy were entered into with the provinces, and extensive resettlement became an emergent need. It was, therefore, deemed advisable to reorganize the P.F.R.A. to meet the situation. As a result three definite branches were organized. First, the cultural branch, which is administered by the Dominion Experimental Farms Service, the major activities of which comprise soil drifting control measures, soil surveys, regrassing, soil reclamation stations, tree planting, and all other factors affecting a more permanent soil conservation program. The second branch is Land Utilization. The main activities consist of establishing community pastures by taking sub-marginal land out of cereal production, the resettlement of farmers on irrigation projects and the movement of settlers to other areas. The third branch is Water Development, which administers the construction of larger irrigation projects and the co-operative building of small projects with farmers such as stockwatering dams, dug-outs and small irrigation projects. The branches of Land Utilization and Water Development are administered by the P.F.R.A. office in Regina.

Land Utilization

The main activities of the Land Utilization program have for the most part been confined to the province of Saskatchewan where community pastures and reserve areas are being set up by virtue of an agreement between the province of Saskatchewan and the Dominion. Under the provisions of the Saskatchewan-Dominion agreement, tracts of sub-marginal or non-arable lands are transferred to the Dominion Government, fenced, regrassed where necessary, and otherwise improved for pasture purposes. The areas are then made available to and administered for, the benefit of adjacent settlers who by a combination of better lands and the use of these pastures are in a much better position to withstand abnormally dry years.

In many locations, it is also possible to conserve sufficient water for irrigation to ensure winter feed which, together with pasture privileges make a self-supporting unit based on live stock, thus affording the greatest possible degree of security to the farmer and stockman. Val Marie, Downie Lake and Souris River are examples that can be given of projects where community pastures combined

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[2]Superintendent of Water Development, P.F.R.A., Regina, Sask.

with irrigation make a complete farm or ranch unit.

A live stock policy is also being instituted as part of the community pasture development. For the first year the Government supplies the bulls, and a total of 79 pure-bred animals of the highest quality and of the leading beef breeds have already been purchased. The objective is to make these pastures breeding centres where the very highest quality of beef cattle will be produced. Having laid the foundation for the production of live stock of a high quality, it is proposed to carry the program one step further and institute an optional marketing plan, if and when sufficient commercial cattle are produced to justify the setting up of such a plan.

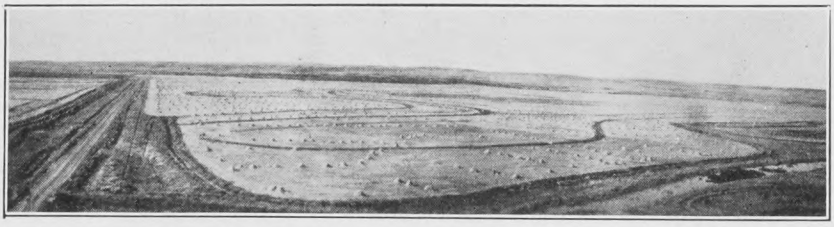
The thought is that these pasture projects will provide an additional as well as a more regular and dependable source of farm revenue, and at the same time put non-arable lands to the best economic use. The fees are fixed on a "per head" basis instead of the customary acreage basis. There is also complete control in the number of live stock that will be pastured in these areas, thus avoiding overstocking and exploitation of the grass lands, a practice which has been all too prevalent in the past. This policy permits a greater measure of range conservation.

In all the pasture development propects, the greatest problem is to find suitable locations for the families hard and unremitting toil, they have not been able to become self-supporting, and if left in their present locations there is no prospect that they ever would become self-supporting.

The pastures now constructed and also the areas under investigation are lands. After experiencing years of now resident upon these non-arable without exception of the sub-marginal or non-arable land class. A study of the soil map of Saskatchewan will disclose the extent of the areas that should be taken out of cultivation and made available for grazing only.

Another interesting situation is the way in which these areas are found interspersed with areas where the land is of an excellent quality for the production of field crops, a circumstance of nature that is not without value if we have the wisdom to take full advantage of it. Certainly, the world is not in need of these sub-marginal areas at the present time for the production of bread grains, and hence they must be set aside as "commons" and reserved for pasture purposes of tremendous advantage to farmers resident on adjoining good lands.

The policy can be boiled down into a sentence or two. The Land Utilization Branch of P.F.R.A. is putting forth an organized effort to correct some of the mistakes that were made when this open plains section of Western Canada was first opened up



Land that was previously non-productive, brought under irrigation to grow feed and seed for farmers on the highland, (note contour ditches).

for settlement. Families are being moved from locations where they have been unable to maintain a decent standard of living without state assistance, and placed in new and approved locations where they can become self-supporting again, and what is also important, regain their courage and self-respect. One must affirm most heartily the soundness of such a policy.

Water Development

1. Large projects.

The larger irrigation projects are intended to benefit a whole community where rehabilitation and resettlement is necessary. The total investment cost is borne by the Dominion Government. The irrigation water is brought to a group of farmers organized under appropriate Acts of the provincial legislatures. The general policy is designed to serve two definite needs, (1) To enable farmers in crop producing areas to have sufficient irrigable land in order to ensure seed, feed and food supplies, and (2) To ensure feed supplies in those areas where farm abandonment has taken place, and where a live stock policy is being developed in the adjoining lands.

In Saskatchewan where the problem is by far the most acute, it is estimated that 275,000 acres in large and small projects may be irrigated. Conservatively estimated, this area would produce approximately one half million tons of feed, which would, in all probability, eliminate the necessity of securing feed supplies from outside the province, even in the driest year.

In the province of Alberta, it is estimated that, in addition to the area already under irrigation, at least another 589,000 acres—not including the North Saskatchewan river project—may be economically developed, making a grand total in the two provinces of nearly two million acres capable of producing, annually, a dependable tonnage of feed and fodder equal to over three times the requirements of the entire drought area in the driest year on record.

In this connection it is well to point out that the water storage near the head of the large rivers and streams is a very important matter. This is particularly true in the province of Alberta. Storage water at or near the source of large streams will provide water for the extension of existing irrigation projects. It enables further virgin land to be irrigated. The investment cost per acre is usually very low, enabling the resettling of farmers at a low cost to the Dominion Government. The soundness of this policy has already been demonstrated in the Rolling Hills project in Alberta. There are several such projects under way at the present time which will greatly assist in the resettlement problem.

There has been a great deal of publicity relating to the North Saskatchewan project, known as the "William Pearce" scheme, for which preliminary surveys were made by the Dominion Reclamation Service years ago. This project involves the diversion of the North Saskatchewan, Clearwater and Red Deer rivers to Sullivan lake in Alberta, where storage can be created up to a maximum capacity of 1,700,000 acre feet. From these streams, regulated by reservoirs in the mountains, it is estimated that sufficient water may be delivered from Sullivan lake to irrigate in round figures 1,411,000 acres of which approximately an area of 486,000 acres is in the province of Alberta and 925,000 acres in Saskatchewan.

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Agricultural Improvement Associations

by

C. Shirriff*

Agricultural Improvement Associations, vital factors in the P.F.R.A. program, are something new in farmer organizations. One of the major problems facing the P.F.R.A. at its inception was soil drifting and related drought problems. It was fully realized that no matter what recommendations were made, the organization of the farmers themselves was prerequisite to the adoption of any change in farm practice. Machinery was therefore set up immediately whereby groups of farmers could organize in what are now called Agricultural Improvement Associations. These associations are devoting their efforts to the cultural side of the question. They are striving to overcome the vagaries of nature in an area where agriculture is normally a hazardous occupation. They are learning new methods of cultivation and developing new systems of farming to meet the demands of changed conditions. The problems embrace production and subsistence with a view to making farmers self-sustaining in the event of drought years occuring in the future.

While the Agricultural Improvement Association movement began in 1935, with the inception of the P.F.R.A. program, there were some farmer associations of this type formed in 1934, in the territory surrounding the Swift Current Experimental Station. The original organizations were voluntary strip-farming associations, organized with the help of Experimental Station officials from Lethbridge and Swift Current. The Shaunavon, Gull Lake, Aneroid and Limerick districts had all made a start in an organized way to control soil drifting before the P.F.R.A., through the Experimental Farm Service, took up this work on an extensive scale. This movement, started by the farmers themselves, and encouraged by the P.F.R.A., has grown to include 192 organizations with an active membership of over 30,000 bona fide farmers.

The aims of these associations, from the standpoint of the farmer members, are chiefly to learn and apply new methods of agriculture, with the hope that the prairie drought area can be made productive and habitable. It is evident that methods used when the country was settled must be changed to meet changing conditions, and it was in an effort to make these changes in a sound and practical way that the Agricultural Improvement Associations were born. The Experimental Farms in the drought area have been working for years on dryland farming practices and under the P.F.R.A. this work has been extended to Experimental Sub-stations where the experiments are tried under varying soil and climatic conditions. Agricultural Improvement Associations take this work one step further and a direct contact with the farmer is made.

The responsibility for administering the work of these associations has been given to the Experimental Farms Service, each station looking after the organizations in the territory served. As a rule no effort is made on the part of Government officials to organize new associations. It is felt that if they are to operate successfully on the self-help plan, the urge to organize must come from the farmers themselves. If the farmers have the desire to or-

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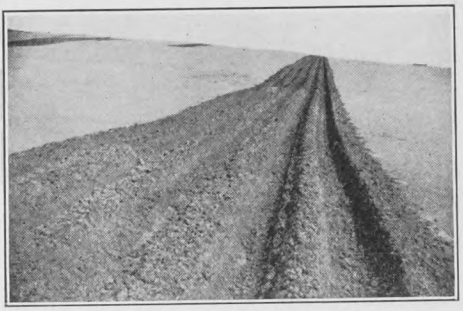
ganize, it will be because they have some special problems that require the concerted effort of all in the community to solve.

The soil drift control problem is one that requires a great deal of educational work and the co-operation of all farmers in the district. The building of community dams, the control of insect pests and the establishment of tuberculosis-free areas are other problems that can only be undertaken by well organized communities.

When a request is received from a group of farmers to have an Agricultural Improvement Association in a district, an agricultural supervisor is sent from the nearest Experimental Station. A preliminary meeting is usually held at which the objects of these associations are explained to the group. If it is found that the farmers are willing to proceed with a constructive program, the organization work is completed either at once or at a more suitable time. The supervisor offers assistance in getting the association under way but does not exercise any control over its affairs beyond guiding it along strictly agricultural lines.

The assistance given to recognized Agricultural Improvement Associations is chiefly of an educational nature although some material help is given to encourage certain activities. A small amount of financial assistance is given in the form of an annual grant, to carry on the administrative work of the organization. This makes it possible to dispense with a membership fee, which even though small, might bar some from becoming active members. The amount varies according to the size of the Association and is sufficient to cover such expenses as stationery, postage and the rental of halls for public meetings.



Lister-furrowing on badly drifted good farm land.

Grass seed of suitable kinds, chiefly crested wheat grass, has been distributed in small quantities to members. The purpose of this distribution has been to enable each member to establish a seed plot from which he could produce seed sufficient for future needs. This plan has met with considerable success, and has been the means of producing many thousands of pounds of seed. The ultimate object of this plan is to seed abandoned farm lands to pasture, and to increase the pasture on the farm itself. In farm-grazing areas, the establishment of pastures is basic to the rebuilding of the live stock population. The educational program through the A.I.A.'s has been directed towards this end. Farmers are fully conscious of the fact that grass and feed reserves are prerequisites to any live stock plan and do not wish a recurrence of drought movement of live stock, as in 1937.

Tree planting has been encouraged, both in an educational way, and by supplying trees with cartage paid, to all farmers in the drought area. The value of a good farm shelterbelt has been well demonstrated during the past few years of drought. Many excellent gardens have been grown from the moisture supplied by drifted snow around the protected plots. Some farmers have taken advantage of this

additional moisture by using it to grow plots of alfalfa and grasses which yield a supply of hay even in very dry years. The development of a shelter belt is the start of a permanent farm home.

Other assistance given through the P.F.R.A. to Agricultural Improvement Associations has varied in different parts of the drought area, but in all cases it has been given, not because of its cash value, but rather to establish and give momentum to some plan or activity. For example, complete crop failures over large areas for successive years depleted and exhausted the supply of good seed, with the result that many were forced to use seed of inferior quality. Associations have been encouraged to obtain small quantities of pure seed which are increased and supplied to members. Certified seed potatoes have been procured and distributed in small quantities to members. A start has been made in some sections to supply, in a small way, suitable varieties of garden seeds and hardy fruits, just to demonstrate to members the value of using the best varieties, and to encourage them to try out new ideas.

This assistance given by the P.F.R.A., and the activities it embraces, is small in comparison with the contribution made by the members themselves. Chief among the many activities is the educational feature of the program. Many farmer meetings are held each year, at which the local problems are discussed. When the occasion requires scientific information, a speaker is procured from the nearest Experimental Station to address the gathering and lead the discussion. These discussions, where the scientific agricultural worker and the farmer tackle the problems together in a practical way, are the backbone for the development of future agricultural policies.

This work is extended further by the Experimental Farm Service in the form of actual experiments with Agricultural Improvement Association members. New theories on farm practices are carried out in a practical way, in co-operation with farmers. Records of the work done and results obtained are kept by the agricultural supervisors. By this system of experimentation, every conceivable method of soil drift control, and every type of implement available, has been explored to the fullest extent. The result has been that farmers have discovered for themselves some practical means within their power of controlling their drifting soil even under severe conditions.

In addition to solving cultural problems, this experimental work is being carried to new fields. Experiments on water conservation and soil conservation are being conducted. Various types of terracing and dyking experiments are being conducted for the purpose of learning the value of this work in conserving the run-off water, and preventing soil erosion. These experiments are conducted by the Experimental Farms, at the request of Agricultural Improvement Associations, and in co-operation with the members.

Experiments for the control of insect pests are conducted in a similar manner, particularly the control of the sawfly in connection with strip farming.

In summing up the work of Agricultural Improvement Associations, it might be said that farmers of the drought area, through these organizations, are taking the responsibility for solving their own problems. Realizing

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Organized Methods of Soil Drifting Control

By A. E. Palmer*

One of the chief activities under the P.F.R.A. is the control of soil drifting.

It was clearly recognized that the causes of wind erosion and the nature of damage done by drifting soil were problems of the community as well as of the individual since drifting not only injured the field from which the soil moved but the drift soil blew over adjoining fields, covered up fences and roads and filled the air so full of dust that life on farms and urban centres in the vicinity at times was almost unbearable. This situation made it imperative that organized effort be adopted to help meet the situation. This became especially evident where farmers had adopted satisfactory control measures on their own farms, but where neighbours permitted soil to blow from improperly handled fields and the dust laden wind started the protected fields to drift, sometimes causing large areas to become involved. Where many farms were included in a continuous drifting area, it was found necessary to bring the entire acreage under control before any farm could be safely handled.

Some organized attempts to meet the soil drifting situation had been undertaken before the establishment of P.F.R.A. Near Monarch and Nobleford, Alberta, a group of farmers from Holland who originated the practice of strip farming, had gradually developed the idea that the entire territory must be stripped if individual fields were to be made safe. Before 1930 they demonstrated the effectiveness of this idea by almost entirely eliminating drifting and resultant dust storm damage in their district.

A group of farmers from Rosetown, Saskatchewan, hearing of the success of the Nobleford experience, visited that locality in the early thirties and many of them adopted strip farming.

In southwestern Saskatchewan, strip farming associations were organized at Shaunavon, Gull Lake, Aneroid and Limerick, before the P.F.R.A. program was launched. Although very little activity was displayed until 1935, both Shaunavon and Limerick were definitely on their way.

Since the establishing of Agricultural Improvement Associations, many of the old organizations and newly formed associations have featured organized control of soil drifting. This was especially true in southwestern Saskatchewan and southern Alberta, where the conditions were most acute.

The Limerick Strip Farming Association succeeded in getting a large majority to adopt the strip farming method. Good results were obtained and the system has been adopted by practically all farmers in the district.

At Shaunavon, Saskatchewan, a large percentage of farmers voluntarily adopted strip farming and the highest type of co-operation was shown. Difficulties arose in 1937 when the crop failed to grow but emergency measures were used in which listed strips replaced the stubble strips and the 1938 crop was well protected.

Following the disastrous spring of 1937, most of the area served by the Swift Current Experimental Station was in a badly drifted condition. Stubble strips were gone and there

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was no trash or weed growth to afford protection.

The spring of 1938 saw conditions at their worst in the territories served by the Swift Current and Lethbridge Stations, and it was then that the real value of a well organized Agricultural Improvement Association was felt.

In southwestern Saskatchewan at Shaunavon, Pambrun, Tompkins, Pennant and Cabri, large areas of drifting soil had to be controlled and it was necessary to have all farmers commence work at once. A meeting was held at each point, the co-operation of all secured and a local man appointed by the Association to run the project under the direction of the Agricultural Supervisor of the Experimental Station. All farmers started work the same day and laid their fields out in strips of eight or ten rods using furrows to make the division. This checked the drifting temporarily and made it possible to successfully work the land. Alternate strips were listed solid, and the others seeded to crop.

An exception to this method was seen at Cabri and Pennant where the land is the heavy gumbo type. Here, in some cases, farmers felt that the best method was to work the field completely and quickly. They concentrated all available machinery and power on one field at a time and were successful in controlling the drifting.

The farmers displayed a fine spirit of co-operation in the face of great difficulties. At Tompkins, Saskatchewan, for example, the first attempt to work the whole area of 30,000 acres failed due to heavy winds coming up before sufficient work had been done to hold the soil. The work was started the second and then the third time before being completed. A good crop was finally established and the whole area completely controlled.

The Swift Current Station reports practically no damage from soil drifting in areas where Agricultural Improvement Associations are established under their direction. This is in contrast to conditions on the Empress line from Abbey west and north to Leader. No organized soil drift control work had been done there previous to the spring of 1939 and little educational work had been carried on with the farmers. Associations now have been formed and efforts are being concentrated in that district where drifting was bad this year.

Last year at least one soil drift control experiment was carried on with each Agricultural Improvement Association in the Swift Current territory. This was an experiment to learn the best use of various machines or methods.

Soil drifting control work supervised by the Brandon Farm has been limited principally to District Experiment Sub-stations and Reclamation Stations but some field days were held by Agricultural Improvement Associations demonstrating the effect of tillage on soil pulverization.

The Indian Head Experimental Farm has done much of its soil drifting control work on Reclamation Stations upon definite requests for such work from municipalities or organized associations interested in local agriculture. Such stations are located at Craik, Aylesbury, Kisbey, Britannia, North Portal, Forest Glen, and Estevan. Thirty-six Agricultural Improvement Associations also have provided an effective medium for disseminating information and stimulating endeavour for drifting control.

In the territory served by the Scott Station, practically all of the major areas of drifting soil have been converted into community pastures. This is another type of organization that is helping to solve the drifting problem by maintaining non-agricultural areas as grass lands after they have been reclaimed and regrassed by the nearest Experimental Station staff.

The soil problem has been foremost in the list of activities of many Agricultural Improvement Associations in southern Alberta. The subject has been discussed at many meetings; members have taken a keen interest and have instituted recommended control methods on their farms.

The Bindloss A.I.A. set up a soil conservation committee which assisted in organizing an attack on the problem in that area. The committee made a very thorough survey of the district to locate the parcels of land which were drifting so badly that the farmers concerned were helpless to effect a remedy or to produce crops. Machinery from the Experimental Station was taken into the district to demonstrate emergency methods and a number of badly drifting fields were brought under control. The fields were listed in strips and the intervening strips were seeded to wheat. In all instances a satisfactory control was achieved in spite of the fact that this district was extremely dry in 1938 and very little growth of any kind developed. At Acadia Valley, Retlaw and Armada, similar situations were met.

On the invitation of the Cereal A.I.A. the Lethbridge Station cooperated successfully with that body in an effort to reclaim three very seriously drifted areas. The officers of the Cereal Association gave assistance wherever possible and kept the experiments before their members as an object lesson, applicable in many instances to their individual farms.

Aside from the co-operative work in the Lethbridge Station's territory mentioned above, twenty-five sets of lister shovels for attachment to farm cultivators were purchased and loaned to the Associations to assist members to bring drifting soils under control. Approximately 100 farmers took advantage of the service and all reports on their utility have been enthusiastic.

Four used two-bottom corn listers were procured in the spring of 1938 and altered to meet the needs of farmers who had a drifting problem but lacked adequate equipment to solve it. These listers were loaned to Associations for the use of their members. Exceptionally good results were achieved by men using these listers under quite varied conditions and particularly so where a field cultivator equipped with listing shovels could not be used with success.

These activities, in conjunction with aggressive educational campaigns in all A.I.A.'s have combined to make the people soil control conscious. Statements by A.I.A. officials received at the Lethbridge Station show the very appreciative reaction to this work.

The main responsibility, however, must rest with the farmers on the land and their individual and especially their united efforts will determine the degree of success that will be attained. The splendid accomplishments in many localities show what can be done and justify hope that eventually all will unite in a determined effort to conserve our greatest heritage, the soil.

Establishment of Community Pastures and Policies of Resettlement

By O. FREER[1] and M. MANN[2]

THROUGHOUT the settled portion of the Prairie Provinces, there are many tracts of land which are sub-marginal for economic crop production. Much of this land was brought under cultivation during periods of high rainfall and good prices for farm produce. Under subsequent unfavourable economic and weather conditions, however, many farms on sub-marginal land have been abandoned to weeds and drifting, unfit for either crop production or grazing. In order to re-establish good grazing conditions on such land, and to prevent it from being broken again for crops during possible future periods of good prices and high rainfall, many sub-marginal areas are being formed into permanent community pastures under the P.F.R.A. program. This phase of P.F.R.A. work was started in 1937.

Each area selected for a community pasture is fenced, supplied with stock-watering facilities, corrals, etc., and steps are taken to improve the grass cover. When a pasture is ready for use, grazing rights are accorded to neighbouring farmers, who are organized into a Grazing Association. This Association co-operates with the Dominion Government in the management of the pasture. The cost of maintaining a community pasture is met from grazing fees, which are set by the Prairie Farm Rehabilitation Branch.

During the season of 1937, 16 community pastures were constructed embracing some 177,480 acres of sub-marginal land, and enclosed with 408 miles of five strand barb wire fence. In 1938, 17 community pastures were completed and 8 are in process of completion, embracing 642,520 acres enclosed with 768 miles of fence. This makes a total to June 1, 1939, of 41 community pastures with a total area of 820,000 acres, and a total fence mileage of 1,176.

For the grazing season of 1939 there are 32 community pastures in active operation; these are under the supervision of pasture managers appointed by and responsible to the P.F.R.A. for the efficient and proper management and control of the pastures.

Grazing Associations have been formed, and an advisory committee elected in each area where a community pasture is now operative. The duty of this advisory committee is to assist the pasture manager in enforcing whatever regulations are necessary and in the best interest of the pasture and the pasture patrons.

It should be pointed out that in all community pastures located in crop or mixed-farming areas where stock is coming and going to and from the pasture throughout the entire grazing season, it is absolutely necessary to establish and set the grazing fee early in the season in order that the pasture manager, who is held responsible for the collection of fees, may know what rate to charge and collect before stock is delivered. The rates in 1938 were 50 cents per head per month for cattle; 75 cents per head per month for horses; with a breeding charge of $1.50 for cattle. At every organization meeting held, the rates as established in 1938 were recognized as only a

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starting point. They were agreed to by resolution on the understanding that any deficit or any surplus would be carried forward as such on each pasture's financial statement for the incoming year. No doubt this will be the practice on which each season's fees will have to be established.

In the program of controlled grazing last year (1938) nature co-operated in a wonderful way. An excellent growing season produced a grass growth that was abnormal in Western Canada. As a result the carrying capacity of all the pastures was tremendously increased. Under the direction of the Experimental Farms, a grass survey of the pastures has been made. Carrying capacity was definitely established on a scientific basis, making provision for reserving winter grazing areas for horses and permitting enough grass in each pasture to mature and reseed itself each season and to provide a coverage that will hold the snow.

After giving due consideration to all factors that affect the operating costs of these pastures, rates for the 1939 season were made on a sharply lower scale. The schedule provided for 35 cents per head per month for cattle; 50 cents per head per month for horses, and a $1.00 cattle breeding fee. These rates applied to all except the Govenlock, Nashlyn and Battle Creek pastures, the rates for which were set at the July round-up.

It might be of interest to state that for the week ended May 20 the stock in the three last mentioned pastures was as follows:—

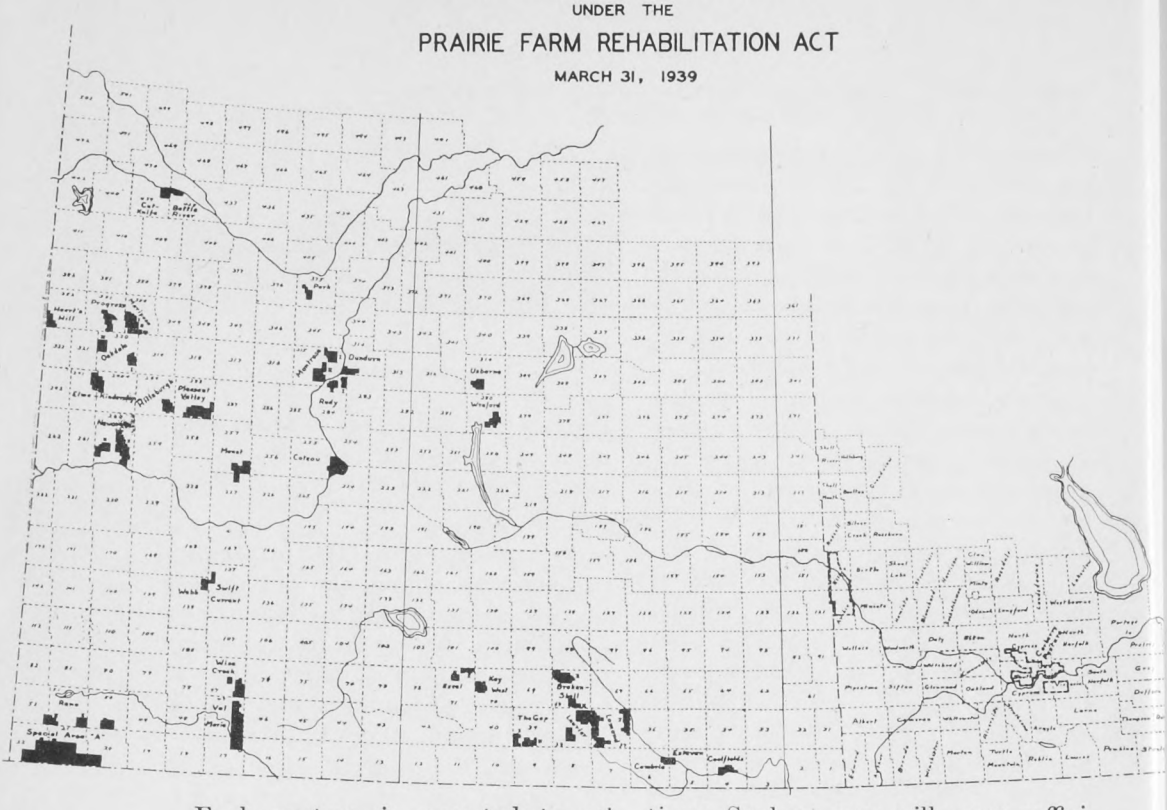
Nashlyn Pasture	1,193 Cattle	85 Horses
Battle Creek Pasture	782 Cattle	115 Horses
Govenlock Pasture	618 Cattle	67 Horses

For the same week the total number of stock on the 32 pastures in operation was 4,605 cattle and 1,552 horses. These figures will serve to indicate the usefulness of these community pastures in the new agricultural set-up in the dry areas of Western Canada.

Cattle resting at a depot on the Nashlyn Community Pasture

As a result of the 1938 experience in operating community pastures, it was decided to set for the 1939 season a minimum charge of the monthly rate for stock grazed on the pasture for a period of less than one month. This was found necessary in order to discourage the putting of stock in these large pastures for just a few days. The Department is also insisting that the pasture manager is entitled to a week's notice for the delivery of stock so as to give him a chance to round it up and have it available when required.

Nothing has done quite so much to popularize these pastures as the Government's policy of heading each pasture with the best type of bulls available. Giving the pasture patrons the right to decide on the breed they wish to develop in their community pastures and then furnishing them with this breed is another feature which is much appreciated. It is not putting it too strongly to say that it is the general concensus of opinion that this bull policy with its reasonable service charge will be reflected in a rapid and marked improvement in the production of commercial cattle in Western Canada. There are 79 bulls located in the 32 pastures; 45 being Herefords, 29 Shorthorns and 5 Aberdeen Angus.



Each pasture is expected to set aside a percentage of the earnings from fees collected as a reserve from which to provide for bull replacements when necessary and for the maintenance and upkeep of fences.

In the selection of pasture managers men are chosen who have the confidence and respect of the pasture patrons. They must be good stockmen and know at a glance whether stock is doing well or otherwise. In other words, in setting up these pasture organizations the Department is earnestly trying to develop leadership in matters pertaining to breeding and management.

The work of the pasture managers will eventually develop into a year-round job. For this reason it would be wise in future to consider only the construction of 15,000 to 20,000-acre pastures which represent an economic unit to operate. A community pasture of this size can be looked after by one pasture manager with a little additional help at odd times. Such an area will carry sufficient stock at a reasonably low rate to pay all operating and maintenance costs and provide a reserve for bull replacement purposes.

In all sub-marginal areas where there are abandoned lands, these fields have been neglected so long that the gopher menace is a very serious problem. An intensive poisoning campaign was put on in 1938 and again in 1939 but it will take three or four seasons before the situation is under proper control. In connection with this work as well as with the clearing of weeds from the fences, assisting at round-up, branding, and vaccinating for blackleg, etc., the pasture manager will require extra help. In some cases it may be necessary to give the pasture patrons a pick-up service in connection with the collection and delivery of stock. Such items of expense as these will, of course, be chargeable to each pasture as maintenance and operating costs.

Fireguards have been placed at strategic locations in all pastures. Each pasture when completed is designated as a game preserve and under the provision of the Land Utilization Act, all community pastures automatically become legal pounds and pasture managers are gazetted as pound keepers.

There are within the community pastures in operation 18,100 acres of weed-infested lands which have been reseeded to crested wheat grass, sweet clover and brome. Excellent stands have been produced. The reseeding policy will no doubt increase the carrying capacity in a short time.

There are now 820,000 acres of sub-marginal lands within community pastures completed or in process of completion. This means that quite a large percentage of the poorest land and the sparsely settled areas in Saskatchewan have now been taken out of cultivation, and the settlers adjoining these areas provided with permanent pasture. That there are still large areas which should be serviced in the same way is clearly indicated by the fact that applications for community pastures have been received from 90 Municipalities.

Resettlement

Resettlement work under the P.F.R.A. consists largely of moving farmers from community pasture areas to new irrigation projects. This work has naturally been slow. It has required from two to three years to construct and develop the irrigation projects and the community pastures. It has been necessary to make a thorough survey of the settlers on land not suitable for cultivation. The resettlement policy has depended upon the conditions existing in a particular area. In the main, however, the broad features of the policy are as follows:—

1. Community Pastures.

If a settler is located on sub-marginal land within a proposed community pasture, he is given assistance to move to better land outside the pasture or to other suitable land within the province or to established irrigation projects under the P.F.R.A.

2. Irrigation Projects and Community Pastures

If a settler is located on land that is declared sub-marginal and which is adjacent to an irrigation project he has the opportunity of moving to a unit of land on the irrigation project.

3. Resettlement Projects and Good Farm Land

A farmer located on sub-marginal land is given the opportunity of moving to a newly developed irrigation project. For example, the Rolling Hills project in Alberta has been settled by farmers from southern Saskatchewan.

The basis of settlement and assistance given is as follows:—

1. Arrangements are made to take the farmer at no cost to himself to the area. He is shown the new location and the possibilities for more permanent agriculture.

2. Three cars of free freight assistance are allowed for the movement of live stock and equipment.

3. The assistance provided under the water development branch is extended to him.

4. The Saskatchewan Government guarantees direct relief for a period of one year if it is necessary.

5. The Saskatchewan Government provides seed, feed and fuel to seed 100 acres of crop on each farm.

6. The farmer is allowed $2.50 per acre for breaking land on his farm or on adjoining land in the area.

The items 5 and 6 are to be returned to the Saskatchewan Government as soon as the farmer is able to do so. They are direct charges against the land.

During 1939 some progress was made in the resettlement of farmers from sub-marginal land in southern Saskatchewan. Those who were moved early in 1939 had over 3100 acres in crop.

Other Resettlement Projects

The Val Marie Project in the Frenchman river valley is one of rehabilitation rather than resettlement. The large area of grazing land adjoining the project and the additional abandoned farm land being regrassed, provides conditions suitable for live stock production. The irrigable units are developed essentially for feed production. The present policy is to lease the irrigable units to the adjoining farmers for one year. If at the end of this time the settler is satisfactory, a purchase agreement is given to him. The purchase price of the land is $10.00 per acre for unimproved land and $12.50 per acre for improved land, i.e., land that has been levelled, ditched, and ploughed ready for crop. A small initial payment is required and the balance is spread over a long term of years.

The Eastend project also in the Frenchman river valley is different from the above projects. It is located in a more favourable farming area, but the odd dry year occurs, resulting in seed and feed shortage. It is essentially a project to ensure feed, seed and food supplies for farmers operating dryland farms adjoining.

The rehabilitation policy is to lease 40-acre units to each farmer within a two-mile radius for a period of three years. During this time, sale agreements are made with the farmer, provided satisfactory progress has been made.

Settlement policies vary with each project. There are many projects nearing the point of completion which will enable more extensive resettlement in 1940 and future years. It will be necessary to work out many of the problems of resettlement as they arise.

AGRICULTURAL IMPROVEMENT . . .

(Continued from page 34)

that old methods must be replaced by new, they are exploring every channel to discover better methods of farming, and are making use of Experimental Farms and agricultural workers to a greater extent than ever before. Giving up the idea of a small fortune and an early departure from the country, farmers are planning a less spectacular but more permanent type of agriculture. A home with pleasant surroundings is replacing the barren temporary habitation. Small irrigation schemes to ensure feed supplies and a garden, are making the life on the prairies less hazardous, and good cultural work on the better pieces of land is replacing the large scale, "shot-gun" methods of the past.

Grazing Surveys and Regrassing Program

By S. E. CLARKE[1], G. D. MATTHEWS[2] and R. W. PEAKE[3]

A SURVEY of the grasslands of Saskatchewan and Alberta was started in the summer of 1937 as one of the activities of the Prairie Farm Rehabilitation program.

It was realized that the native vegetation is the most profitable crop that is likely to be produced over large areas in the drier and rougher portions of these two provinces. It was apparent also that large areas had been brought under cultivation that should have been left as native sod and used for grazing purposes. Many of the native grass pastures had been overgrazed during the recent dry years with the result that they were in a weedy and badly depleted condition.

It was quite evident that it was necessary to "take stock" of the grazing resources, to determine the nature and condition of the native plant cover, the carrying capacity of different pastures, their suitability for different classes of live stock and for use during different seasons of the year.

It was necessary to determine how these pastures could be improved by such means as the development of additional watering places, reseeding, etc., and to devise grazing practices that would ensure the maximum utilization of the herbage compatible with the upkeep of the pastures in a highly productive condition.

Other activities under the P.F.R.A. involved the setting apart of special areas and the development of community pastures. Individual ranchers and groups of stockmen became interested in knowing more about their pastures and how they should be managed, and requested that the pasture studies being conducted at the Manyberries Range Station be extended to other areas. Such factors as those given above were largely responsible for the inception of the grassland survey in the summer of 1937.

Grassland surveys have two principal functions, (1) to render assistance in the classification of lands concerning their suitability for different agricultural purposes such as cereal-crop production, the production of hay crops, grazing, etc.; (2) to furnish information concerning native pastures, the nature and condition of the grass coverage, the carrying capacity of the pastures, how the carrying capacity might be increased and how such pastures should be managed. In other words, surveys help to determine what areas should be left as native sod for grazing purposes and how pastures should be managed.

To the trained ecologist, all plants are indicators; the native vegetative cover is an expression of environmental conditions, physical and biotic. The nature of this native herbage indicates soil and climatic conditions, as well as the effects of such biotic disturbances as cultivation, grazing, burning, rodent injury, insect damage, etc. Therefore, the native plant species indicate the suitability of an area for the production of different crops. For instance, such cereal crops as wheat and oats are tall growing grasses which require a long season

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in which to make their normal growth and reach maturity. If the native vegetative cover of an area consists chiefly of tall, long season grasses such as certain species of Stipa (spear-grass), Agropyron (wheat grass) and Andropogon (blue stem) it may be concluded that the area is probably suited for the growing of cereal crops. On the other hand, should the native vegetative cover be composed mostly of dwarfed, short season species such as grama grass, Sandberg's blue grass and nigger wool (*Carex filifolia*) it would probably be advisable to leave the area as native sod for grazing purposes. In land utilization studies, soil and botanic surveys should go hand in hand.

It is fortunate that previous to the inception of grazing surveys on a large scale in 1937 such work had been conducted at the Dominion Range Experimental Station at Manyberries, Alberta. Starting in 1928, methods and technique involved in pasture studies were developed. University graduates engaged as assistants at this Station were trained in the work until they knew the native species on sight, had a fair knowledge of their palatability, nutritive value, growth, habits, etc. They were also trained to chart quadrats, measure the density of cover, determine yields and carrying capacity.

When, in the summer of 1937, it was decided to apply these studies to other areas, there was no loss of time in getting the work under way. One survey party, consisting of two men with a car and necessary equipment, was placed in the field and nearly half a million acres were surveyed during the remainder of that summer.

During the summer of 1938, two survey parties were at work and by the late fall of that year nearly one and a half million acres had been covered. Maps and reports covering this area were completed. The areas surveyed included the following:

Areas	When surveyed	No. of Acres
Berry Creek, Alberta	1937	322,560
Tilley East, Alberta	1937	55,680
Ranches in Alberta	1937	162,560
Special Area, Val Marie	1937	51,840
Special Areas, southern Sask.	1938	202,260
Community Pastures, Sask.	1938	202,760
Ranches in Sandhill Area, Sask.	1938	404,600
Total		1,402,260

Application to Land Utilization

These surveys have been used to a considerable extent in connection with special areas such as those established at Val Marie and Maple Creek. They are of great value in the determination of what sections should be used for cereal or forage crop production, what parts should be used for grazing purposes and the season of the year when each portion of the pastures should be grazed. They also show the acreage of abandoned fields, what portions should be reseeded and give other information concerning native hay production, carrying capacity of pastures, the development of stockwatering places, etc., all of which is essential in planning the utilization of such areas.

Application to Community Pasture Management

After a community pasture has been established and fenced, it is surveyed as soon as possible. A study is made of each quarter section concerning its topography, soil type, water development, land utilization, vegetative cover and condition of pasture. The information concerning the vegetative cover includes: (1) the name of the various plant species with a discussion concerning their prevalence and value; (2) the grass cover in per cent, the cover of non-

grass species in per cent and the total percentage vegetative cover; (3) a discussion on browse plants and weeds; (4) carrying capacity; (5) indications and extent of overgrazing.

Under land utilization, abandoned fields are dealt with. The total number of acres abandoned, the portions that should be reseeded and a description of the weed cover are reported on.

Suggestions are made concerning the general management of the pastures and these complete reports are sent to the Prairie Farm Rehabilitation office in Regina, to the pasture managers and to the Superintendents of the Experimental Stations concerned.

Individual ranches are dealt with in much the same manner, the ranch owner being given a full report in each case.

In all of these grassland surveys a complete list is made of all plant species found in each district. This will enable the various species to be mapped to show their distribution and prevalence throughout Saskatchewan and Alberta. Specimens are collected for the herbarium at the Swift Current Experimental Station where nearly 1000 species have been identified and mounted.

REGRASSING ABANDONED LANDS AND DEPLETED PASTURES

The large scale regrassing of abandoned lands and depleted pastures was started in 1935 as a part of the Prairie Farm Rehabilitation program. During the preceding dry years large acreages of farm lands had been abandoned throughout the drier parts of the three Prairie Provinces. These abandoned fields became covered with annual and perennial weeds which had little value either for hay or pasture. In addition, drought and overgrazing had seriously damaged the stands of grass on native sod, and in many cases unpalatable weeds had taken almost complete possession of areas which previously had been good range land. Particularly on abandoned farm lands, natural regrassing is a slow process which requires up to twenty years or more, depending on climatic conditions and several other factors. In the meantime such areas would have little value as pasture. Fortunately it has been found that the regrassing of such areas can be greatly accelerated by artificial reseeding and since 1935 a considerable acreage has been sown to cultivated grass and legume crops.

Abandoned farm lands comprise the greater part of the acreage seeded. In some cases these lands were in a permanently drifting condition and it was necessary first to seed them to rye or some other cereal crop in order to obtain a cover among which to sow the grass seed. In the regrassing of depleted pastures, in some instances crested wheat grass has been sown directly into the native sod while in other cases it has been found necessary to break up the pasture in order to destroy undesirable species before any seeding was done.

In conducting this regrassing program, the following different phases of the work have been developed:

1. Reseeding in community pastures.
2. Regrassing reclaimed areas.
3. Regrassing experiments on special areas.
4. Regrassing demonstrations.
5. Establishing seed production plots.

Reseeding in Community Pastures

During the past few years a large number of community pastures have been developed. Many of these pastures contained large acreages of abandoned farm lands most of which

had a good cover of weeds. Certain portions, however, were in a badly drifted condition and a stubble or weed cover had to be obtained before seeding could be practised. It was thought advisable to get a grass cover on these fields as quickly as possible and over 25000 acres already have been seeded.

Regrassing Reclaimed Areas

In each of the Prairie Provinces there were considerable areas of bare drifted soil which needed to be reclaimed and brought into production. Many of these areas already have been reclaimed by following suitable cultural practices and by seeding to such cereal crops as rye and barley. As soon as sufficient cover was obtained, the land was seeded to grass in order to obtain a permanent cover that could be used for hay or grazing. Several thousand acres of such lands already have been regrassed.

Regrassing Experiments on Special Areas

A number of abandoned fields representing different soil conditions and different types of weed cover have been used for experimental purposes. On these special areas different rates and methods of seeding as well as different cultural methods have been tested. While crested wheat grass has been used mostly, other grasses and also a number of legumes have been tested to some extent. This work has been given special supervision and study. In some cases quadrats have been charted in order to determine the per cent stand obtained and the spread of the grass, from year to year. Such studies have been of great value in providing exact information on suitable crops to use and on the best cultural practices to follow in order to obtain good stands.

Regrassing Demonstrations

In this project, seed has been distributed to farmers and ranchers who had land that was suitable for reseeding and who were in need of additional hay and pasture. The object is to conduct two or three regrassing demonstrations in co-operation with interested stockmen in each district where there is a need for considerable work of this nature. Seed has been provided for from five to twenty-five acres in each demonstration and the farmer does all work according to instructions given him. A member of the Experimental Station staff inspects each field at least once a year. Several hundred demonstrations are being conducted and good stands have been obtained in 75 per cent of the seedings made. This policy has resulted in many fine demonstrations on the handling of forage crops in the dry areas. A number of the operators have harvested seed and are seeding down larger areas while others have purchased additional seed for the same purpose.

Establishing Seed Production Plots

This work is done under the supervision of the Agricultural Improvement Associations. Samples of grass seed of about 10 pounds each are distributed to members of an Association, the seed being used to establish a seed plot. A large number of these plots have been established and crested wheat grass is becoming widely recognized and available as a result.

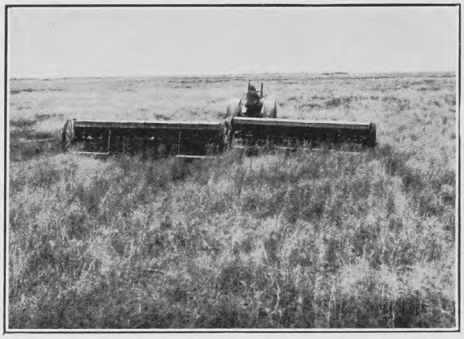
Methods of Seeding and Cultural Practices

Fortunately, previous to the initiation of this work as a part of the Prairie Farm Rehabilitation program, seed of a suitable grass had been made available and satisfactory

methods for obtaining stands had been developed. Abandoned fields were seeded to crested wheat grass at the Dominion Range Station near Manyberries, Alberta as early as 1928. Here it was demonstrated that crested wheat grass was suited to this purpose, and dependable methods for obtaining stands were developed. The Fairway strain of this grass was developed at the University of Saskatchewan; farmers turned to the production of seed of this hardy crop and by 1935 considerable seed was available. Recently large quantities of seed have been produced and it can now be purchased at reasonable prices.

As a result of tests conducted at the Dominion Experimental Stations throughout the drought area, the following practices can be recommended:

Crested wheat grass should be seeded either in the fall or as early as possible in the spring. Seedings made early in September usually give the best results provided there are not many grasshoppers present at that time. Seed should not be sown on summer-fallow or other bare ground unless there is no danger of soil drifting. Seedings made among grain stubble or a cover of Russian thistle or other annual weeds give good results. The seed should be sown through every other spout of the seeder, at the rate of five or six pounds per acre and at a depth of not over one inch. A double-disk drill should be used. The removal of all pressure including the release of springs is recommended unless the ground is very hard. Broadcasting the seed is not recommended but if it is seeded in this manner the ground should be disked after seeding. It is a good practice to mix some legume seed such as alfalfa or sweet clover



Seeding crested wheat grass on abandoned land in a community pasture. Seeding is usually done by local farmers.

with the grass seed. A mixture consisting of five pounds of crested wheat grass and two pounds of legume seed, is recommended. In this case seeding should be deferred until just before freeze-up or done early in the spring. Brome grass and the legumes usually do better if seeded in the early spring.

In seeding abandoned fields having a cover of annual weeds, the seed should be drilled in among the weed cover without any cultivation either before or after seeding. With every other disk removed the seeder will pass through a heavy growth of Russian thistle or mustard although some difficulty is experienced when the weeds are wet. In the case of fields that are covered with perennial weeds such as prairie sage (*Artemisia frigida*) it is more difficult to get good stands of grass established. Grass seed may be drilled in among the weed cover and fair stands obtained. In a few years time the grass will replace the sage, resulting in a good stand.

Depleted native pastures can be regrassed by following the same practices as outlined for abandoned fields having a perennial weed cover. In many cases good stands of crested wheat grass have been obtained by

drilling the seed into the native sod. Usually good stands are obtained more quickly by double-disking the sod, previous to seeding. If the farm pasture consists of arable land it is a good practice to bring it under cultivation, grow a good grain crop on it the first year and then sow the grass seed among the stubble during the fall months. Usually it is a good practice to conserve the top growth during the first year. However, if a good stand has been started and plenty of moisture is available it may be cut for hay or grazed lightly.

As suggested previously these various agronomic problems had been largely solved before large-scale reseeding was undertaken. However, the experience of the past two years has resulted in marked progress in solving the problems of suitable equipment and management necessary to regrass large areas. When the work on community pastures started in 1937 feed was scarce and horses were generally in poor condition. As a result, horses were used only for small isolated areas and power equipment was found most suitable where large tracts of land had to be seeded. The most economical unit used was a rubber-tired tractor pulling two 24-run seed drills. The cost per acre for seeding with this unit was 24 cents, or less than half the cost where horse drawn units were used.

Another important consideration in the use of power machinery is that the tractor can be kept operating for a 24-hour day. In the rapidly shortening days in the fall season, night seeding is a necessity if large acreages are to be sown. Three eight-hour shifts with the tractor unit described resulted in the seeding of an average of 155 acres per day in 1937. In 1938 this acreage was increased to 194 acres per day. This increase was accounted for largely by increased efficiency of the operators; increased speed of the tractor by the use of over-size instead of standard tires, and by changing from seeding up and down to seeding around the field. Seeding around the field avoids delays in turning and in swinging markers, and makes it easier to follow the mark when seeding at night by artificial light.

Night seeding, contrary to general opinion, gave very good results. A comparison of the three shifts starting at 8 a.m., 4 p.m. and midnight shows no appreciable difference in the acreage seeded. A partial explanation of this fact is that the engine operated more smoothly and slightly faster at night. The main reason, however, is no doubt due to the choice of the more level areas for night seeding, as the rougher fields were left to be seeded in daylight.

The results of the regrassing program have been very noticeable throughout the area served by the Prairie Farm Rehabilitation Act. Farmers and ranchers have gained confidence in their ability to establish a stand of grass by the use of recommended methods. As a result large areas of abandoned land and unproductive pasture have been reseeded and are now producing up to four or five times the amount of hay or pasture obtained previously. Also, crested wheat grass has proved its ability to live through dry periods and hence the stands which have been seeded will remain productive as long as they are unbroken. Another outcome of the program is the recognition of the ability of crested wheat grass in a long-time rotation to add fibre to the soil and thus control soil drifting. This fact will undoubtedly have a stabilizing effect on grain farming in the prairie region.

Water Resources for Irrigation in Western Canada

by

B. Russell*

The trite old axiom that "you cannot make a silk purse out of a sow's ear" applies as well to irrigation as to other forms of human endeavour, and every plan for further irrigation development in the West is governed by the available water resources of the Prairie Provinces. Further, because it is mainly the southern portion of this area which requires irrigation, this article is confined to a review of possibilities in the drought area of the Prairie Provinces.

The supply of water for use in the drought area is obtained from three sources, namely, those streams which rise in the mountains; those which are less permanent and find their source in the hills; and other miscellaneous supplies of water which, although small as units, are important in aggregate for irrigation purposes.

The mountain streams are the most reliable and permanent water supply. As the headwaters of such streams flow in shallow valleys and have considerable fall, it is possible to divert them by gravity to irrigable tracts. In the foothills there are some ten such larger streams, which measured at the points at which they could be diverted, would average about 11,000,000 acre feet. A portion of this water is already being used, but much more can yet be diverted by gravity canals. Eight of these streams unite in Alberta to form the South and the two others form the North Saskatchewan river. The average annual flow of the North and South Saskatchewan rivers, measured at Prince Albert and Saskatoon, respectively, is 6,700,000 acre feet and 8,000,000 acre feet.

Throughout the eastern part of Alberta and in the provinces of Saskatchewan and Manitoba these streams flow in deep wide valleys from 200 to 500 feet below the prairie level and cannot, therefore, be diverted by gravity. The junction of the North and South Saskatchewan rivers is at a point in Saskatchewan above Fort A LaCorne and thus united, these waters empty into lake Winnipeg in Manitoba.

Some of the larger prairie streams, and particularly those which rise in the Cypress hills, can be used to irrigate small areas of land, and even the small and sporadic streams can be useful for flood irrigation during short periods in the spring. With regard to the larger irrigation streams, accurate measurements and other data have been compiled over a period of years, and it is now possible to estimate, with a reasonable degree of accuracy, the average yearly flow of each. It is more difficult to determine even approximately the proportion of those waters which can be diverted and economically used to irrigate land, but figures provided by the Dominion Reclamation Service from systematic topographical and hydrometic surveys permit an estimate as to the location and extent of lands and reservoirs to which available water supplies can be diverted by gravity canals. The results of such surveys are shown in the accompanying tables and represent the most authentic records at present available as to water resources which can be used for irrigation development.

There are in addition to these mountain streams prairie streams to which reference has already been

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made and from which a comparatively small amount of water can be taken for irrigation purposes. Over twenty such streams rise in the Cypress hills and despite the fact that they either dry up completely in the summer, or at least become very low, they furnish water to the exetent of about 337,000 acre feet per year, taken on a twenty-year average.

There are no statistics from which an estimate of other stream flows in the southwestern drought area can be made, but it is probable that together such other streams might have a combined average annual flow of from 200,000 to 300,000 acre feet.

Recapitulating what has been estimated to be the annual water resources in the drought area, the result is as follows:

Mountain Streams	11,000,000 ac. ft.
Prairie Streams	3,000,000 ac. ft.
Miscellaneous	2,000,000 ac. ft.
Total	16,000,000 ac. ft.

The following table represents the most reliable estimate available as to the extent of land which by use of storage reservoirs can be irrigated from existing water supplies:

Possible storage for irrigation	5,964,130 ac. ft.
Storage in operation or under construction	860,210 ac. ft.
Lands known to be irrigable	3,434,320 acres
Lands under existing canals	824,790 acres
Lands now receiving water (approx.)	450,000 acres

It is evident therefore, that there is a prima facie supply of 16,000,000 acre feet of water per year available for irrigation purposes in the drought area. But these figures tell only part of the story. There are at least five governing factors which condition the actual available water supply, and its possible utilization, and the volume of water which can actually be put to beneficial use must necessarily be some small proportion of this 16,000,000 acre feet, depending on these factors. Any estimate of the water resources is therefore incomplete without a recognition of these conditioning factors and it is proposed in the following pages to enumerate them and to discuss their relation to irrigation.

The first of these factors is storage possibilities. If the flow of water in the streams were relatively stable from month to month and from year to year, the task of providing irrigation facilities would be relieved of many of its complexities. But such is not the case. Instead, almost the entire flow in most of the streams is recorded in a few short weeks of spring run-off and then the subsequent supply of water from the streams is comparatively small. This means that without some facilities to control and regulate the out-put of the stream most of the water comes at a time, and in such volume as to render it practically useless.

From what has been said there is a need for adequate storage facilities from which conserved spring floods may be released to furnish moisture for agriculture during dry periods. Without a knowledge of storage sites it is impossible to determine even approxi-

Dam constructed at Val Marie, Sask. Capacity 6000 ac. feet.

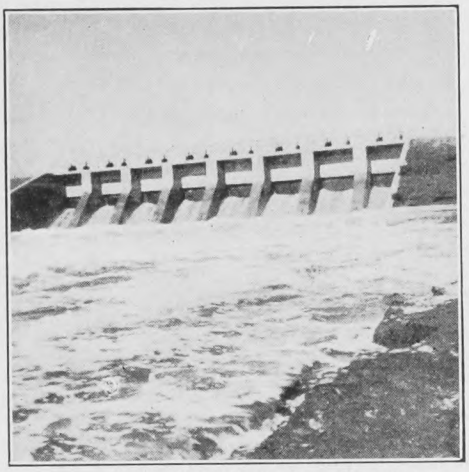
IRRIGATION SYSTEMS SURVEYED OR UNDER CONSIDERATION IN WESTERN CANADA

	Name	Irrigable acres	Source
1.	Eastern Irrigation District Extension	254,000	Bow River by storage
2.	Canada Land & Irrigation Co. Extension	158,000	Bow River by storage
3.	Lethbridge S. E. Project	345,300	St. Mary, Waterton, Belly by storage
4.	South MacLeod Irrigation Extension	40,000	Oldman River by storage
5.	Eyremore Irrigation Project	4,100	Bow River by storage
6.	Retlaw Lomand Project	50,000	Bow River by storage
7.	River Bow Project	5,800	Bow River by storage
8.	Champion Irrigation Project	50,000	Highwood River by storage
9.	Little Bow Irrigation District	3,000	Highwood River
10.	Granum Irrigation Project	4,500	Willow Creek by storage
11.	Beaver Creek Irrigation Project	2,800	Beaver Creek by storage
12.	Pincher Creek Irrigation Project	16,200	Pincher Creek by storage
13.	Rockey Coulee, Barron and other extensions	57,000	Oldman River
14.	Todd Creek Irrigation Project	8,600	Todd Creek by storage
15.	North Saskatchewan Project	1,400,000	Red Deer and Clearwater by storage
16.	South Cypress Hills Project	7,000	Frenchman River and Butte Creek by storage
17.	Bright Water Creek Irrigation Project	2,000	Brightwater Creek (flood irrigation)
18.	Pinto Creek Irrigation Project	500	Pinto Creek (flood irrigation)
19.	Swift Current Creek Irrigation Project	15,000	Swift Current Creek by storage
20.	Skull Creek Irrigation Project	930	Skull Creek by storage
21.	South Sask. River Pumping Project	3,500	South Saskatchewan River
22.	Qu'Appelle River Irr. Development	8,000	Qu'Appelle River
23.	Vanguard Irrigation Project	4,000	Notukeu Creek by storage
24.	Harte Butte Irrigation Project	300	Poplar River by storage
25.	Bear Creek Irrigation Project	5,000	Bear Creek by storage
26.	Sage Creek Irrigation Project	3,000	Sage Creek by storage
27.	Bull Pound Creek Irrigation Project	500	Bull Pound Creek by storage
28.	Plum Creek Irrigation Project	500	Plum Creek by storage
29.	Other Community Projects	60,000	Small Streams
30.	Other Private Schemes	100,000	Small streams

mately the water resources available for irrigation development.

The next factor to be discussed is the feasibility of gravity diversions. The possibility of conveying water by gravity canals is dependent firstly upon the distance of the stream below the lands to be irrigated and secondly the slope and fall of the stream itself. If, to take an extreme example, the river were 200 feet below the surrounding area and the fall were four feet per mile, it would require a canal of over 50 miles in length to bring the water by gravity on to the prairie level, an obviously uneconomical device for irrigation purposes. As a matter of actual fact, even in the foothills the points of diversion are very limited, so that without a complete survey for the full length of the stream it is not possible to determine the economy of any gravity diversion project. Sufficient surveys have been made on the larger streams, however, to disclose economical points of diversion, with the result that irrigable areas can be approximately determined.

A further factor which makes the area of land available for irrigation an indefinite quantity is the question as to what amount of water is required to produce a crop. Even supposing it could be said with some certainty that there was available



The spillway, Val Marie dam. Permanent concrete structures are necessary to pass the heavy flood of water in the spring, when the reservoir is filled to capacity.

11,000,000 acre feet of water for agricultural purposes, the problem of how much land could be irrigated with it is still far from being solved because there is no arbitrary minimum amount of water per acre which will guarantee a successful crop. Not only does the quantity of water for crop production vary in different places, but it also varies at the same place from year to year. For example, under the Irrigation Acts, the legal duty of water, that is, the amount of water to which the holder of a water right in an irrigation district is legally entitled is 18 inches, but experiments in certain locations have shown that this figure is perhaps too high and that 12 inches of irrigation water, depending on rainfall, etc., is more like the amount of water required for agricultural production in certain considerable areas. Since the data do not exist upon which any positive figures as to the duty of water can be set, this is but another reason why the irrigable area can not be positively determined.

Another point for consideration is the economic value of irrigation. Should we regard irrigation in the narrow light as to whether or not, in dollars and cents, it pays to rehabilitate a certain tract of land, or are we to take a broader sociological view, having regard not only to benefits to the individual tract of land itself, but also to the welfare of the adjoining community and the welfare of the people at large? Until recently, the former view that the irrigated land must bear all the costs was generally adopted. Upon this basis an attempt has been made to determine the value of land and water rights by the potential possibilities for the production of crop and live stock on irrigable lands. The Ewing Commission has determined that for irrigable lands on the larger projects in Alberta the amount of capital expenditure cannot exceed $20.00 to $25.00 per acre, depending on the location of the land and other factors. Under the former theory the area which can be irrigated is definitely limited by the ability of the land to pay capital, maintenance and operating costs.

But what of the latter, that is, the sociological view? The basis of this theory is that a rural population of prosperous and contented farmers is of benefit, not only to merchants in the adjoining towns in the form of reliable customers, to the rural municipalities in the form of steady taxpayers, but to the Nation as a whole, as loyal and contented citizens and as contributors to the national wealth. Since, therefore, a large group outside of the actual farmers themselves are indirect beneficiaries of any improvement in the farmers' economic position, advocates of this theory maintain that these other beneficiaries should share the cost of their increased prosperity.

Unfortunately this latter theory raises problems of the utmost practical difficulty. If the land is not to

bear the entire cost of its own irrigation, what proportion should it bear. It might be argued that it should bear none, but only the cost of maintenance plus some fraction of the initial capital expenditure. And if it is to be the maintenance cost plus some fraction of the capital outlay, just what fraction should be taken? The truth is that these questions do not admit of any definite answers and hence the ultimate irrigation development in Western Canada cannot be predicted.

Another important factor is that of existing pumping possibilities, which again resolves into a question of economics. It is, for example, manifestly uneconomical to spend a dollar pumping water to sixty cents worth of produce. There is, nevertheless, at the other end of the scale a point where pumping with cheap power may be justified by the value of the crop grown. A gasoline or Diesel power plant makes the cost of pumping more than 25 to 30 feet prohibitive. Using cheaper natural gas as fuel this height may be increased, and by employing water power there is practically no limit to the height to which water might be pumped for irrigation and the development of irrigation. Such latter schemes imply an inter-connected system of water power and pumping plants, a development now advantageously used in many American projects, and possibilities in Canada merit most careful scrutiny.

IRRIGATION SYSTEMS CONSTRUCTED OR UNDER CONSTRUCTION IN WESTERN CANADA

	Name	Irrigable acres	Source
1.	C.P.R. Western Section	218,980 (a)	Bow River by Storage
2.	Eastern Irrigation District	121,000	Bow River by Storage
3.	Canada Land & Irrigation Co.	42,000	Bow River by Storage
4.	Alberta Railway & Irrigation Co., C.P.R.	87,000	St. Mary River
5.	Taber Irrigation District	21,660	St. Mary River by Storage
6.	Magrath Irrigation District	5,000	St. Mary River
7.	Raymond Irrigation District	6,400	St. Mary River
8.	Lethbridge Northern District	93,000	Oldman River partly by storage
9.	United Irrigation District	34,000	Belly River
10.	New West Irrigation District	4,500	Bow River by Storage
11.	Mountain View Irrigation District	3,400	Belly River by Storage
12.	East End Irrigation District	2,900	Frenchman River by Storage
13.	South MacLeod Irrigation District	10,000	Oldman River
14.	Val Marie Irrigation District	5,000	Frenchman River by storage
15.	Middle Creek Irrigation District	2,000	Middle Creek by storage
16.	Leavitt Irrigation District	7,000 (c)	Belly River by storage
17.	Maple Creek Irrigation Project	6,000 (d)	Maple Creek by storage
18.	Souris Estevan Irrigation Project	3,900	Souris River by storage
19.	Dunn and Watt Irrigation Project	300	McEachern Creek Flood Irrigation
20.	Davidson Irrigation Project	200	Squaw Coulee by storage
21.	Kisbey Flats Irrigation Project	2,300 (d)	Moose Mountain Creek by storage
22.	West Val Marie Irrigation Project	4,000	Frenchman River by storage
23.	Big Arm Irrigation Project	5,000 (d)	Last Mountain Lake by storage
24.	Moose Jaw Creek Irrigation Project	2,250	Moose Jaw Creek by storage
25.	Robsart Vidora Project	3,000	Battle Creek by storage
26.	Rolling Hills Irrigation Project	25,000 (b)	Bow River by storage
27.	East Berry Creek Irrigation Project	1,000	East Berry Creek by storage
28.	Community Projects by P.F.R.A.	20,000	Small streams, Alberta
29.	Private Schemes prior to P.F.R.A.	70,000	Smaller streams in Provinces
30.	Private Schemes by P.F.R.A.	18,000	Smaller streams in Provinces

(a) Facilities constructed for this area by only small percentage yet irrigated.
(b) Extension of Eastern irrigation district but not included in 121,000 acres.
(c) Ultimate irrigable area.
(d) May be extended if water supply proves sufficient.

Irrigation Reservoirs Surveyed or Under Consideration in Western Canada

	Name	Irrigation Project	Capacity Ac. Ft.	Remarks
1.	Gap Site	Lethbridge Northern Irrigation District	90,000	Also provides for extensions
2.	Castle River Site	" " " "	30,000	" " " "
3.	Canyon Site	" " " "	40,000	" " " "
4.	Mountain Storage	North Saskatchewan Project	794,000	
5.	Sullivan Lake Site	" " "	1,500,000	
6.	Buffalo Lake	" " "	1,200,000	
7.	Tramping Lake Site	" " "	320,000	
8.	Frank Lake	Champion Irrigation District	74,000	
9.	St. Mary River Site	Lethbridge South East Project	250,000	Also provides for Alberta Railway and Irrigation Co.
10.	Waterton River Site	" " " "	25,000	" " " " " " "
11.	Milk River Forks	" " " "	30,000	" " " " " " "
12.	Chin Coulee Site	" " " "	102,000	" " " Taber District
13.	Verdigris Lake Site	" " " "	140,000	
14.	Milk River Reservoir Site	" " " "	80,000	Also provides for Alberta Railway and Irrigation Co.
15.	Raymond Reservoir Site	" " " "	17,000	" " " " " " "
16.	Pincher Creek Project	Pincher Creek Irrigation Project	5,000	
17.	Gladstone Reservoir Site	Pincher Creek Irrigation Project	1,000	
18.	Five Mile Creek Site	Beaver Creek Irrigation Project	3,500	
19.	Lac Des Arcs		200,000	On Bow River near Canmore
20.	Ross Creek Site	Private schemes in Ross Creek	8,220	
21.	MacKay Creek Site	" " " MacKay Creek	2,527	
22.	Manyberries Creek Site	" " " Manyberries Creek	11,000	
23.	Skull Creek Site	Skull Creek Irrigation Project	3,873	
24.	Bear Creek Site	Bear Creek Irrigation Project	9,900	
25.	Qu'Appelle River Sites	Qu'Appelle River Irrigation Project	50,000	
26.	Avonlea Creek Site	Lands along Moose Jaw Creek	7,000	
27.	Notukeu Creek Site	Vanguard Irrigation Project	16,000	
28.	Maple Creek Reservoir Site	Maple Creek Irrigation Project	10,000	
29.	Tenaille Lake Site	" " " "	2,000	
30.	Bullshead Creek Storage	Lands on Bullshead Creek	1,200	
31.	Lee Creek Storage Site	Private lands on Lee Creek		Capacity not determined.
32.	Harte Butte Reservoir Site	Harte Butte Irrigation Project	800	
33.	Berry Creek Reservoir Site	Lands on Berry Creek		Capacity not determined
34.	Plum Creek Reservoir Site	Plum Creek Irrigation Project		" " "
35.	Swift Current Creek Site	Swift Current Irrigation Project	30,000	
36.	Small Community and Private Dams	North Sask. Irrigation Project	50,000	

There are many factors favourable to such a system. The seasonal flow of the streams actually facilitates a reciprocal power and pumping scheme the following way: Since the ratio of summer to winter flow on most of the rivers is about six to one, hydro-electric plants located on such streams must have generating or storage facilities, which in summer give them a power potential many times greater than that required for the maximum winter load. If available for irrigation, these facilities could be used not only to increase the summer flow of water in their own drainage basins, thereby increasing irrigation possibilities, but also to generate cheap power to pump water to lands on other basins which could not otherwise be irrigated.

One of the most fertile possibilities for such a reciprocal power and pumping system can be seen in the case of the Bow and Red Deer rivers in Alberta.

Power plants upon the Bow river provide a large amount of power to Alberta consumers, and to generate the maximum winter load expensive facilities, such as high dams equipped with generating units, storage reservoirs and other equipment, have been installed. As yet there has been no appreciable clash between the agricultural and power interests upon the Bow river, but it is inevitable that with further expansion such a conflict will arise.

The Bow river is by long odds the most important agricultural stream in the drought area and the maximum amount of its water will in future have to be utilized to fill the needs of adjacent irrigable lands. If, therefore, the present power facilities on the Bow were used for irrigation purposes, spring floods could be stored up and released as needed during the summer months and there would be power, and lots of it, for pumping water for irrigation on other drainage basins.

It is in this connection one might consider the Red Deer river system. The Red Deer is a large river with splendid storage facilities, but as yet it has been of little use for irrigation purposes, because there has been no economical way to raise its water up to the prairie level. If, however, the cheap and abundant power developed upon the Bow during the summer were to be tapped and used for pumping purposes, vast tracts of land could be irrigated from the water of the Red Deer river. But that is not all. Since it has already been pointed out that the water on the Bow must be used for agricultural purposes, the question arises as to where the power will come from to supply the heavy winter power load which the Bow is no longer able to handle. The answer lies in the Red Deer river. Just as in the summer months the generators upon the Bow provided the necessary electricity for pumping purposes on the Red Deer basin, so in the winter, power units upon the Red Deer would supply the winter power load for the idle turbines on the Bow, for there is more than enough cheap storage on the Red Deer to supply both its agricultural needs in the summer and its power needs in the winter.

Thus, by loaning and borrowing power as the need arises, these two complementary systems could provide for the maximum amount of water for irrigation, the maximum amount of power for industry, and the maximum social service to the communities which they serve.

The by-products of this proposed system are also of considerable im-

IRRIGATION RESERVOIRS CONSTRUCTED IN WESTERN CANADA

	Name	Irrigation Project	Capacity Ac. Ft.	Remarks
1.	Lake Newell	Eastern Irrigation District	187,300	
2.	Sutherland Site	" " "	8,000	
3.	Kowoki Site	" " "	14,000	
4.	Lake McGregor	Canada Land and Irrigation Co.	300,000	Also provides water for extension.
5.	Kanaskis Lake	Bow River Calgary Power Co.	40,000	Now used to develop power.
6.	Lake Minnewanka	Bow River Calgary Power Co.	69,000	" " " " "
7.	Little Bow Site	Canada Land and Irrigation Co.	30,000	Also provides water for extension.
8.	Driggs Lake	Leavitt Irrigation District	7,000	Also provides water for Mountain View Irrig. Dist.
9.	Keho Site	Lethbridge Northern Irrigation District	40,000	
10.	Wild Horse Site	Private scheme on Sage Creek	4,500	
11.	Cypress Lake Site	Val Marie, Eastend, Robsart, Vidora and other projects on Battle Creek and Frenchman River	70,000	
12.	Adams Lake Site	Private schemes on Battle Creek	2,000	
13.	Downie Lake	Maple Creek Irrigation Project	10,000	
14.	Middle Creek Storage	Private schemes on Middle, Battle and Lodge Creeks	20,000	
15.	Bartman Dam	East Beirry Creek Project	3,000	
16.	Souris River—Dead Lake	Souris Estevan Irrigation Project	2,600	
17.	Moose Mountain Site	Kisbey Flats Irrigation Project	8,200	
18.	Rough Bark Creek Site	Souris Estevan Irrigation Project	1,500	
19.	West Val Marie	West Val Marie Irrigation District	2,000	
20.	Moose Jaw Creek	Flood Irrigation near Lang, Sask.	2,180	
21.	Pipestone Creek Site	Lands on Pipestone Creek	1,600	
22.	Davidson Storage Site	Lands on Squaw Creek	280	
23.	Lac Pelletier Storage	Lands along Swift Current Creek	3,350	Also provide water for City of Swift Current.
24.	Big Arm Storage Site	Big Arm Irrigation District	5,200	
25.	Val Marie Storage	Val Marie Irrigation District	6,000	
26.	Eastend Storage	Eastend Project	2,500	
27.	Small Community and Private schemes		20,000	

portance. Hydro-electric development upon the South Saskatchewan river has never been feasible because of the uncertainty of winter flow. However, with an adequate winter flow guaranteed from reservoirs on the tributary Red Deer river, power plants could be installed at suitable locations in Saskatchewan and could take care of a large proportion of the power equipment of that province.

There are perhaps other projects as yet undiscovered which could be exploited in this same manner. The extent to which irrigation can be expanded by pumping plants of this kind depends largely upon the uses which can be made of the water resources for irrigation development, but such systems as have been outlined appear to represent the most economical and beneficial way in which many of our available water resources can be used.

The entire problem of water resources available for irrigation development in Western Canada is therefore one of some complexity. Within broad and general limits it is possible to speak with a degree of certainty and to give categorical statistics, but beyond these limits are numerous factors which make it hazardous to attempt anything more than a discussion of the problem involved. Many of these difficulties are due to the fact that figures and statistics are not available. A great many more are human and sociological factors which cannot be measured or gauged by any methods known to engineering. It is therefore only possible to enumerate the facts and figures that have been made available, and admitting the existence of these further conditioning factors, to attempt, as well as possible, to strike some balance between the two.

ORGANIZATION OF THE P.R.F.A. . . . (Continued from page 31)

The main engineering difficulty presented by this project is the diversion of the Red Deer river. Early last summer, the Dominion Minister of Agriculture authorized a detailed survey of the whole project, and P.F.R.A. engineers have been on the ground for months studying the problem to determine the engineering factors involved. If, as a result of the study now being made, the project is ultimately found to be economically feasible, it will be the largest project of its kind in Canada.

2. Small projects.

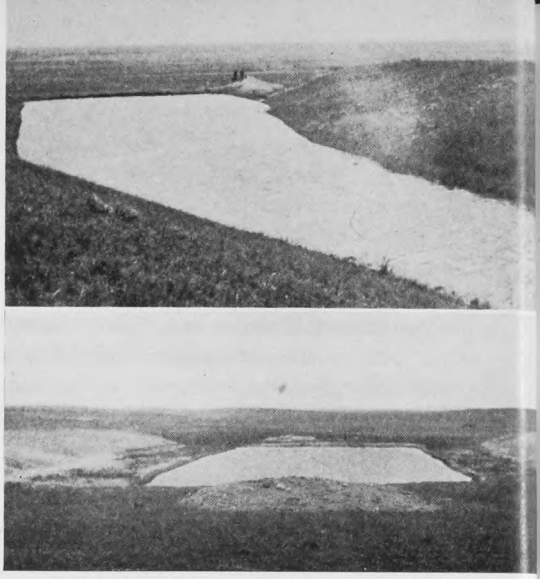
The small projects consist of stock-watering dams, dugouts, small storage irrigation projects and flood irrigation projects. In order to serve the large territory in Western Canada, engineers are allocated to different districts. By this means more direct attention is given to the farmer who has had little experience with irrigation.

The principle behind all small projects is that they are built on the self-help plan. The farmer must contribute his own labour and make provision for a certain amount of equipment. The policy is designed to give every encouragement to the progressive farmer. Possibly no phase of water conservation has received such impetus as these small projects and there is no doubt that they have served the greatest number of people. The results to date are encouraging and every effort is being put forth to increase the activity. From the mass of correspondence and interviews it is evident that the service is proving a veritable godsend to thousands of people resident in the area.

Progress of Small Water Development Projects

by

W. L. JACOBSON*



A typical stockwatering dam constructed by a farm under P.F.R.A. direction and assistance. The lower picture shows a typical dugout constructed on level land. A snow fence 20 feet from the edge of the dugout will collect sufficient snow to fill it.

THE CONSERVATION and utilization of surface run-off water by means of small but widely distributed projects including dugouts and dams is a major activity of the Rehabilitation Branch and has been since the inception of the Prairie Farm Rehabilitation program in 1935. No phase of P.F.R.A. has been more readily accepted or more actively supported by farmers and ranchers and the public generally for the reason no doubt that the shortage of water following many years of low rainfall so vitally affected the daily living and welfare of so many people. In addition, there has been a widespread shortage of water for live stock and for the growing of vegetables and feed. The low-rainfall years of the past decade serve to emphasize the fundamental fact that in spite of mechanization, farming on the prairies is a mode of living or a way of life where the home cannot be considered apart from the farm as a whole. The widespread and devastating effects of drought demonstrate the necessity of making the home the central factor in establishing any kind of permanent agriculture on the open plains and in placing farming in this area on a self-sustaining basis.

The low precipitation is obviously an important characteristic of the prairie climate. It is a fact nevertheless that even in the driest years the amount of precipitation including snow and rainfall that occurs on a square mile varies on the average from 640 to 820 or more acre feet. This problem of growing gardens and raising a limited amount of feed is not so much a matter of precipitation as it is distribution of the precipitation received both in respect to area and time. The principle underlying the use of surface run-off water on the prairies by means of small water developments is simply the concentration of sufficient run-off water from a larger area to a smaller one for effective crop production.

The conservation of surface water by means of dams and reservoirs alone will not solve all the agricultural problems of the prairies. The amount of water that can be conserved in this way is small indeed when compared with the millions of acres of land subject to drought in this region. Moreover, the conservation of moisture for crop production by means of cultural methods such as summerfallow, in contrast to storage of run-off by means of reservoirs, is of paramount importance since cereal production under dryland farming is after all the major industry on the prairies. Small water developments are important nevertheless as a means of conserving and utilizing at least a portion of the surface run-off water that is now going to waste, in order to give a greater degree of stability

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to farming and ranching on the open plains during periods of low rainfall.

In the main, there are three means by which surface run-off water may be conserved: 1. Use of reservoirs; 2. Storage of water in the soil; 3. Production and storing of hay and feed during years of abundant moisture supply for use during the lean years. In this way, moisture is in effect stored in the haystack or the feed bin. The full utilization of all available surface water supplies on the prairies by the above described means would, to a large extent, ensure adequate feed supplies, water for household use and garden irrigation, and adequate and dependable water supplies in connection with range lands during years of low precipitation.

The P.F.R.A. Small Water Development program provides assistance for three main types of developments including the simple dugout which consists mainly of an excavation in the ground for the storage of run-off water below ground level; stockwatering dams consisting of earthen dams and necessary structures and spillways built across ravines or coulees for the storage of water; and individual irrigation projects which vary from the more elaborate systems embracing reservoir, outlet works and diversion ditches to the simpler flood irrigation projects consisting simply of low dykes for the purpose of holding back run-off water and storing it in the soil for subsequent crop production. These types of development are by no means new on the prairies. The early settlers and ranchers, particularly in the foothills country of what is now Alberta and in the Cypress hills, undertook to grow winter fed during years of low rainfall by simply diverting water from smaller streams to irrigate adjacent river-bottom lands, while in the eastern part of the prairies the dugout was used early in the settlement of the country where well water was not available. However, as the rancher gave way to the homesteader and wheat growing took the place of cattle raising, many of the early constructed small irrigation projects were abandoned because these projects had economic value only where used with adjacent grazing lands.

One of the earliest irrigation projects was built near Calgary in 1879 when a rancher constructed works to irrigate fifteen acres on Sheep Creek. In 1894, the Northwestern Irrigation Act was made law, when a convention was held in Calgary and the Government of the day was called upon to deal vigorously with the whole question of irrigation on the prairies. The demand of the public at that time for action was no doubt a factor in the extensive development of larger irrigation projects which was undertaken in Alberta prior to and following the turn of the century when works to irrigate a million acres and more of land by means of large projects had been completed. Interest in connection with small water development projects was confined very largely to irrigation. In 1932 following the transfer of the Natural Resources from Dominion to provincial control there were 342 licensed individual irrigation projects in Alberta and 222 in Saskatchewan and while no information is available regarding the actual acreage under irrigation at that time the 564 projects in the two provinces involved 100,000 acres of irrigable land according to licenses issued.

It was not until after the inception of the Water Development program

MAP II

PRAIRIE FARM REHABILITATION ACT

MAP
SHOWING DISTRIBUTION OF DUGOUTS
AS COMPLETED UNDER THE PRAIRIE FARM REHABILITATION PROGRAM
IN THE OPEN PLAIN AREA OF ALBERTA SASKATCHEWAN MANITOBA
DURING 1935 · 1936 · 1937 & 1938

Dugouts make up nearly 90% of the applications received for assistance in water development in Manitoba Over 7 1/2% in South-eastern Saskatchewan and 32% of the applications from S.W. Saskatchewan and Alberta Since 1935, 5242 dugouts have been completed in the three provinces, including 2614 in Manitoba 2368 in Sask and 260 in Alta. A dugout is simply an excavation in the ground to catch runoff water, and is used largely where construction of a dam is not possible Financial assistance to the end of the last fiscal year was based on 4½¢ per Cubic Yard of earth excavation up to a maximum of $75.00 Financial assistance for the fiscal year 1938-39 was based on 6¢ per Cu. Yd. of earth excavation up to a maximum of $150.00

MAP SHOWING DISTRIBUTION OF STOCKWATER DAMS
AS COMPLETED UNDER THE PRAIRIE FARM REHABILITATION PROGRAM
IN THE OPEN PLAIN AREA OF ALBERTA, SASKATCHEWAN & MANITOBA
DURING 1935, 1936, 1937 & 1938

Over 2326 Stockwatering Dams have been completed in the three Prairie Provinces since the start of the Prairie Farm Rehabilitation Act Program in 1935, including 177 in Manitoba, 1616 in Saskatchewan and 533 in Alberta. For the most part these consist of earthen dams across ravines, draws and coulees, and on the average will store from 3 to 10 Acre Feet of water from spring run-off and heavy summer rains. In addition to Engineering services, financial assistance provided is based on 4½¢ per cubic yard of earth excavated, plus 25¢ per cubic yard for rock and total cost of material, up to a maximum of $150.00 for all 3 items when the project is completed and passes Engineering Inspection.

under the P.F.R.A. in 1935 and after several years of extremely low rainfall, such as probably occurred in the '70's and '90's of the last century, that the possibility of small surface water developments was in any sense greatly appreciated by farmers and the public generally. Since the program was first announced over four years ago, more than 22,000 applications for assistance have been received from individual farmers and ranchers in the three Prairie Provinces of Alberta, Saskatchewan, and Manitoba. It is undoubtedly a fact that an important result so far achieved through the P.F.R.A. in respect to water development has been the awakening of public interest in the possibilities of water conservation through small water developments.

Saskatchewan, with the largest area affected by low rainfall and the largest number of people involved, contributed 62 per cent of the applications up to March 31, 1939, while 22 per cent were from Manitoba and 16 per cent from Alberta. Nearly 57 per cent of the applications on record on that date were for dugouts, about 31 per cent for stockwatering dams and over 12 per cent for individual irrigation projects. Nearly 90 per cent of all applications from Manitoba and southeastern Saskatchewan were for dugouts, whereas 25 per cent of all applications received from Alberta and southwestern Saskatchewan were for irrigation, 48 per cent were for stockwatering dams and less than 27 per cent for dugouts.

The assistance provided through the rehabilitation program for small water development work is based essentially on the idea of self-help to encourage and assist individual farmers and ranchers in storing and using all available surface water supplies. In addition to engineering services that are provided to the extent that staff is available, financial assistance to cover part of the cost of construction is paid to individuals on works that are approved and pass inspection when completed. In the case of dugouts, financial assistance is based on 6 cents a cubic yard for earth excavated up to a maximum of $150 and with stockwatering dams the rate is 4½ cents a cubic yard for earth excavated plus 25 cents a cubic yard for rock work, and cost of materials, up to a maximum of $150 including earth, rock and materials. Financial assistance for individual irrigation projects is on the same unit basis as stockwatering dams but the maximum for any one project is $350. The assistance provided covers approximately one-quarter to one-third of the cost of construction. The main exception to this is the case of dugouts excavated by mechanical means where the assistance provided covers two-thirds or more of the total cost.

On May 31, 1939, over 8,194 projects had been completed or reported completed by individual applicants in the three provinces including 5,288 dugouts, 2,352 stockwatering dams and 554 irrigation projects. Saskatchewan headed the list of completed works with 4,405 completed projects while 2,813 projects were completed in Manitoba and 936 projects completed in Alberta.

The financial assistance provided through P.F.R.A. has made it possible for municipalities and communities to employ mechanical equipment on a large scale for the excavation of dugouts on the individual farms. In addition to furnishing water for household use these dugouts provide adequate water supplies for live stock to permit the full utilization of feed

that may be grown in these areas. In this way the excavation of dugouts is likely to definitely affect the agricultural economy in many of these districts by making it possible for farmers to increase their live stock holdings. With mechanical equipment dugouts are excavated at a minimum cost and adequate depth is obtained for satisfactory storage. While the storage capacity in the case of dugouts is necessarily limited, this storage is being used for irrigation of small gardens and fruit plantations by means of pumping and this type of development is being encouraged as far as possible.

Where topographical conditions are favourable, construction of a dam is recommended in place of a dugout since this type of project usually affords greater storage capacity at a lower cost and provides more satisfactory water supply.

An irrigation project, however, where feasible, is preferred to either a stockwatering dam or a dugout. Up to May 31, 1939, a total of 554 individual irrigation projects had been completed or reported completed in the three provinces including 8 in Manitoba, 376 in Saskatchewan and 170 in Alberta. While this may be considered a fairly large number of projects to have completed during the four years the P.F.R.A. has been in operation, it is believed that irrigation will assume greater relative importance as the rehabilitation work progresses. Up to the present the policy has been to accept applications from individuals and to give attention to these applications more or less in the order received. This procedure has been necessary in order to give assistance where most needed and to relieve the water situation in individual cases. With much of the urgent work completed, however, and the water situation relieved temporarily by more favourable rainfall, a change in procedure will likely be made, in that areas will be selected in each district for the purpose of making complete water and engineering surveys. In this way attention would be directed to areas in the greatest need of water development work and eventually a large part of the open plains area could be covered. Such surveys would be on the basis of drainage areas or units of drainage areas and in addition to obtaining detailed information of probable water supplies and run-off, favourable dam sites and probable irrigation areas would be located. This detailed information would then be correlated with soil, economic and grass surveys of the area and each drainage basin or unit drainage basin would be treated as a separate project for the purpose of any readjustment or resettlement of population that may be found necessary in establishing a system of agriculture adapted to the area. This system has already been undertaken in a limited way in the Special Areas of Alberta. Here the use of vertical aerial surveys where photographs are taken from an elevation of 10,000 feet has been found extremely helpful in defining the boundary of the drainage areas and studying the characteristics of the run-off area including location of probable dam sites and irrigable areas.

The total acreage of land that could be made irrigable by means of small projects in the three Prairie Provinces can only be roughly estimated with the limited information so far available. The present area of some 118,000 acres served by existing individual irrigation works could no doubt be increased two or three times

(Continued on page 84)

Irrigation Development for Resettlement

By W. H. Fairfield[1] and G. N. Denike[2]

Experience has shown that insufficient preparation of the surface of land to make irrigation not only practical but easy of application, has resulted in much dissatisfaction among the settlers who have taken up raw land during the last three or four decades since irrigated land has been opened for settlement on the Canadian prairies. In fact allowing settlers inexperienced in irrigation to go on farms hard to irrigate —on farms that experienced irrigators would not consider as fit for irrigation—has resulted in abandonment and imposed upon the promoters of the project the necessity of resettlement. The officers in charge of water development carried out under the activities of the Prairie Farm Rehabilitation Act, recognize the mistakes that have been made in the past and hope to avoid as far as possible making similar mistakes in any new irrigation developments that they may undertake.

It is obvious to the uninitiated that successful irrigation consists in the even spreading of water over the surface of the soil irrespective of what particular method is used to accomplish this end. The smoother the land is, that is the freer it is from small irregularities, the more easily can the water be spread over it. Not only must all parts of the field be covered with water, but arrangement must be made to allow the surplus to be drained off readily, that is, the water must not be allowed to become ponded in certain portions of the field or the farm. This leads to the question of surface drainage for irrigated farms.

The importance of this drainage cannot be too greatly emphasized. In the past both on the older irrigation districts on the Canadian prairies and also in the United States, the question of drainage has often been overlooked in the beginning with the result that in some cases the cost of the necessary drainage that had to be put in after irrigation had been applied to the land for a few years, was even higher than the first cost of the irrigation works. Therefore, in planning irrigation development resettlement, the question of adequate surface drainage for all lands that will be classed or treated as irrigable must be conscientiously provided for.

Even should all water available for irrigation be suitably conserved and used for that purpose, there would be more land than water. In appraising new irrigation projects, first consideration should be given to the land that is best suited for irrigation not only from a topographical standpoint but from the standpoint of characteristics of the soil, its physical texture as well as its fertility. Even with the selection of the most suitable land available there is usually considerable preparation that could be done to level or smooth the surface to make the spreading of water more practical. In the past this levelling of the land for irrigation has been done by the farmer with the horse power that he happened to have available. Modern power machinery for the moving of dirt has made it possible to prepare land for irrigation that previously would have been classed as non-irrigable, due to the fact that the dirt can be moved at a fraction of the cost involved in the use of horse power. Even on land that would irrigate reasonably well, modern auto-

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Levelling land with the automatic leveller

matic levellers will make it possible at a very small cost per acre to irrigate a given area with considerably less water and with much less labour than would be required had this special levelling not been done.

The fact has already been mentioned that a great deal of disappointment and dissatisfaction was experienced by settlers in the past when attempting to develop an irrigated farm on land having a surface that was irregular and difficult to irrigate. Many of the failures experienced by these settlers would have been avoided had the land been properly levelled and prepared for irrigation at the time the settlers started their work. All this land preparation can be done expeditiously and relatively economically by modern power machinery designed for the purpose.

It should also be borne in mind that many parts of the large irrigation projects in Alberta have lands that are reasonably level and some are practically ideal for the application of water. Because of this the custom has gradually become general to attempt to irrigate any land, for which water is available, without levelling preparations, regardless of its topography. As a result, settlers on these rougher lands have been unable to satisfactorily establish themselves.

Methods of Irrigating: There are different types of irrigation and different ways of applying the water to the land. Regardless of the method of application used, careful initial surface preparation in the way of land levelling, etc., as just discussed, is equally important with each. For hay and grain the water is flooded over the surface, for rowed crops such as potatoes, corn, garden truck, etc., the rows of crop are planted in such direction as will allow water to be run in furrows between the rows of crops, this method being called the furrow system. With the ordinary flooding method, which would include the

greater proportion of the land to be irrigated on the prairies, the locations of the field ditches vary according to circumstances.

The most common arrangement of field ditches is the contour system. This merely means that the field ditches are placed as nearly as possible at right angles to the slope or fall of the land. These are placed at suitable distances apart varying from 100 to 300 feet apart. The water is dammed and taken out of the upper ditch and is allowed to flow across the land, is caught in the next ditch lower down, is again dammed and turned out, thus preventing waste water flowing off the land. The contour system of ditching is used more extensively than all the other types combined.

On particularly flat land, that is, land that has very little fall, parallel ditching, with the ditches running with the fall of the land; the parallel dyke system, and the basin dyke system, or some modification or combination of these three, can be used to advantage.

It is the duty of the experienced engineer to indicate what method of irrigation would be best suited to the particular parcel of land in question. Irrespective of what system or type of irrigation is used, the ease with which the water can be applied to the land and the economy of water, that is, the possibility of covering all parts of the field in a relatively uniform manner with a minimum of manual labour, will depend in very great measure on the amount of preparation or levelling that is done before cropping is begun. The importance of land preparation cannot be too greatly emphasized when considering the question of irrigation development for settlement.

Free Flooding: What has been said has to do with irrigation when water is available in reasonable quantities from running streams or better still from stored water at the time it is required by the crops. However, there is another supply of water coming from the spring run-off resulting from melting snow that sometimes cannot be stored and would otherwise go to waste if it were not caught at once and spread over the land. This is being done more or less extensively in certain parts of both Saskatchewan and Alberta. The fact that the soil usually is frozen when this water is running makes it imperative that it be held in some fashion on the land until the frost draws out and so allows the soil to absorb the moisture. The most common method followed in handling the water under these conditions is to construct low dams across the flats in the valleys. The resulting series of ponds with the water from a few inches to two or three feet deep holds the water until the frost leaves the ground underneath, thus allowing it to soak in and thoroughly wet the subsoil. This method of water conservation, although definitely a form of irrigation, need not be considered particularly in this paper. Such methods are usually applicable to individual farms and the work necessary to carry out the plan can be done by the farmer with some suggestions from an engineer in regard to the location and construction of dykes or dams to be made.

Relocating Boundaries of Land: In the development of an irrigation project where there are a number of sections of land involved, it is often found that the arbitrary or legal boundaries of the section or legal sub-divisions of a section are incon-

venient and interfere seriously with the locating of irrigation ditches in the proper place. The logical procedure to follow under such circumstances, is to disregard the established road allowances, re-survey the land and establish the boundaries of the farm units so that they will conform to the topography of the land. This makes it possible for each farm unit to receive its water at one delivery. It also avoids unnecessary ditches. This re-arrangement of farm boundaries along rational lines so far as irrigation is concerned will prove of inestimable value in the development of many irrigation projects. It will certainly eliminate many unproductive corners and strips of land that commonly become unsightly weed patches and will allow such areas to be utilized as irrigable land.

Follow-up Assistance: It has been found very helpful to institute a follow-up plan to assist beginners in irrigation with the location and construction of their field ditches and in giving some friendly instruction regarding the spreading of water on the land. With these precautions taken many of the vicissitudes experienced by farmers without previous experience in irrigation have been avoided.

MANITOBA AND PRAIRIE . . . (Continued from page 28)

the rehabilitation program, agricultural improvement associations have been formed to supplement the usual educational and inspirational programs. For the maximum contribution to rehabilitation, co-ordination of all such efforts is essential.

In addition to providing inspiration and leadership, various forms of assistance are required to ensure the more rapid adoption of certain practices. In Manitoba there are several districts in the drought area which have stood up reasonably well against soil drifting, but which are now becoming more and more susceptible, and unless preventive action is taken, soil drifting in these districts will become chronic in the near future. Assistance in financing the extensive development of field shelterbelts, and in the periodic seeding down to grass in cases where moist subsoils favour these practices, together with tax readjustments on the basis of returns from the lands so used, should be given serious consideration by this province.

Finally, some local problems in rehabilitation and land use may need the aid of legislation to facilitate municipal action. To this end legislation has been enacted in the "Manitoba Land Rehabilitation Act", under which municipalities can take action if required.

In conclusion it can be stated that the rehabilitation of prairie farms cannot be solved by the application of blanket formulae. The procedure in each district must be conditioned by the local aspects. Governments can and must aid through a combination of education, leadership, assistance and legislation, but the ultimate solution will depend upon the extent to which individuals on the land can be inspired to take over the task when they have been assisted through the distress period.

Soil Erosion Control

by

W. Gibson[1] and P. J. Janzen[2]

Soil erosion by wind is one of the most difficult agricultural problems on the open plains or grain growing areas of the West. This condition is largely due to the misuse of farm implements and the breaking up and cultivation of land unsuited for the growing of cereal crops. In the southern areas of the Prairie Provinces, soil erosion is a particularly serious menace and many farms have been abandoned. This constitutes a problem for the municipalities and a public menace. In some of the most severe drifting areas, such as Cadillac, Estevan, Aylesbury and Kisbey in Saskatchewan, the Dominion Experimental Farms through the Prairie Farm Rehabilitation Act have acquired a number of drifting tracts for the purpose of obtaining information on the best methods of control and permanently tying down the soil with a grass cover. Already sufficient information has been obtained on the various projects to enable a definite statement that the drifting soil can be controlled. Each project may have to be handled differently, varying the type of machinery or using a combination of implements to put the soil in a condition to withstand wind action. These control methods will also have to be varied according to the peculiarity of the soil.

Mechanical Equipment

Certain new types of machinery have been found suitable for soil erosion control. For soil reclamation work the caterpillar type of tractor usually gives the best satisfaction. The tillage implements found most useful are the following: One-way disk with seeder attachment and surface packer, Dempster drill and the duckfoot cultivator, mouldboard and shovel types of listers.

The one-way disk with seeder and packer attachment should be set to penetrate from three to four inches in hard ground. The depth of penetration varies with the amount of drift sand; as long as the sand is not over two inches deep the machine will turn up enough wet subsoil to leave a lumpy surface. When the sand is deeper the surface is not left so lumpy and the surface packer is used to leave the sand and subsoil in a firmly packed condition which usually resists wind action for some time. In places where the sand is too deep for the one-way disk to bring up subsoil the lister is used to check drifting. The seeding attachment on the one-way disk broadcasts the seed which is a decided advantage because the crop covers the ground much more rapidly than if seeded in rows.

Cadillac Reclamation Area, as it appeared before the rehabilitation program got under way.

The Dempster drill and duckfoot cultivator are used on severely eroded areas. The Dempster drill is very similar in action to the duckfoot cultivator in that it leaves the land in a ridged, lumpy condition. This condition is much more resistant to

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wind action than the level lumpy surface left by the one-way disk. As in the case of the latter, when the sand drifts are too deep for the Dempster to reach the subsoil the lister must be used at the first signs of drifting.

The rows of grain sown with the Dempster drill are about one foot apart and so considerable time is required for the grain to cover the ground. This difficulty may be overcome to some extent by removing the grain spouts and sowing broadcast.

When the duckfoot cultivator and the grain drill are used to give the same effect as the Dempster drill the grain should be sown first. If the grain is seeded after cultivation the seeder breaks down the lumps and the ridges which have been formed by the cultivator.

The shovel type of lister is very similar in action to the Dempster drill. It has a greater penetration but less tendency to bring lumps to the surface. It is a very good machine for ripping up land where the hard subsoil is exposed, it will leave such land in a good lumpy condition without excessive ridging. In sandy soil it is not nearly so effective as the mouldboard type of lister.

The mouldboard lister is about the most useful implement for reclaiming badly drifted land. It can handle a much deeper accumulation of sand than other machines because it has a greater penetration and also because it turns the soil over and leaves deep ridges. When this machine has been able to reach the subsoil complete control of the soil drifting has been obtained. When the subsoil is not reached a great deal of the effectiveness is lost because the sand seems to dry out and the furrows fill up quite rapidly. One of the best uses of the mouldboard lister is to keep sand from spreading to adjoining areas.

In the earlier experiments grain was seeded from the corn planter boxes on the lister. This did not prove satisfactory because the grain was

Cadillac Reclamation Area, as it appeared in July, 1938. This crop was seeded in the drift sand with a lister with broadcast seeding attachment.

short and stunted and the rows were far apart, and since the grain was usually so short that it did not come above the lister ridge it was of no assistance in checking drifting. Grain has been sown successfully with the lister, however, by placing a seed box on the machine which would broadcast the seed over the entire area, on the sides and tops of the ridges. This has proved successful in preventing the ridges from filling in even in fairly sandy areas.

The mouldboard lister has one disadvantage and that is the fact that it leaves the land in such a deeply ridged condition that it is not satisfactory for seeding grass. In view of this fact its use should be limited to one of the following conditions:

1. Areas having a deep accumulation of sand which cannot be controlled by other means.
2. For listing narrow strips alternated with strips seeded in the regular fashion.
3. For listing strips through drifting areas to stop the spread of the drifting.

The Use of Rye for Reclamation

Good results have been obtained by seeding spring rye very early in the spring to make use of the moisture from the melting snow. To offset this advantage, however, it required early and extensive treatment to prevent drifting and so it has been found advisable to delay the seeding of the crop till late in May or early in June. When the crop is seeded at this time the spring winds are generally over and the ground is warmer, thus giving a more rapid germination and a hurried covering of the ground. If conditions do not permit seeding until after the middle of June it is advisable to sow fall rye because late seeded spring rye does not produce sufficient stubble to prevent drifting.

In using fall rye for the control of drifting areas, it is advisable to sow it in conjunction with some early maturing barley, such as Sixty Day, which will act as a nurse crop and provide protection for the fall rye, both at germination and during the winter by acting as a snow trap. This combination should be sown late in June or early in July, to give the crop a chance to become well established before the fall winds or before there is danger from migrating grasshoppers. Rye seeded at this time produces a dense growth and even if it does not survive the winter there is enough stubble to check the drifting. When the crop is seeded later than July it is much more susceptible to damage from grasshoppers.

In the reclamation of eroded areas fall rye has been the most important factor. It will grow on poorer soil than most other cereals, produce a very rapid growth and is quite hardy. Because rye volunteers readily it tends toward continuity of the crop once it has become established. Other cereal grains can be used in season but barley is preferable because of its rapid growth in a warm soil. It is quite essential to get a good cover crop to maintain a resistance against the winds. Once a drifting area is cultivated or drifting is controlled for a period of time, weeds rapidly become established.

If the stand of either spring or fall rye is patchy the first year it is advisable to let the grain shatter and leave the stubble untouched. When this is done there will usually be a good volunteer crop the next year. This crop can be harvested and the stubble leaves the land in ideal condition for seeding grass in the fall.

Regrassing

Lack of moisture is the chief problem in seeding cultivated grasses. In the drier areas and on the higher land, crested wheat grass has given very good results. When it has become established it forms a dense sod and is capable of maintaining itself over long periods of drought. Sandy areas having a high water table seem to be well adapted to sweet clover which will produce excellent hay. It is reasonable to assume that alfalfa could be grown in these areas and experiments in this connection have recently been undertaken.

While soil erosion control is definitely an emergency issue to conserve the soil, every consideration should be given to suitable cropping systems and sane cultural methods in order to bring about a permanent solution to the problem.

Methods of Conserving Run-off Water and Controlling Soil Erosion

By J. S. PARKER[1], WM. DICKSON[2] and E. S. HOPKINS[3]

THE SEVERE DROUGHT which has been experienced in the southern regions of the Prairie Provinces for the past nine years has led to much thought and experimental work on methods of conserving and utilizing run-off water for increasing crop yields. Linked very closely with the problem of conserving water is the problem of preventing water erosion of soil.

Methods which conserve run-off for crop production contribute very largely to the control of water erosion. By the use of suitable cropping and cultural practices, and of structures such as terraces and dykes, a percentage of the rainfall normally lost as run-off may be retained in the soil to increase the growth of crops or grass. This combination of decreased run-off and increased plant growth, in turn, serves as an effective method of controlling water erosion of soil.

During the past two years (1937 and 1938) a number of experiments on methods of conserving run-off water for crop production, and of controlling water erosion, have been undertaken as part of the cultural program under the P.F.R.A. by several Dominion Experimental Farms in the Prairie Provinces. These experiments cover such practices as terracing, dyking, flood irrigation, contour furrowing, contour farming, and basin listing. While little of this work has progressed to the point of rendering definite information on the value of the foregoing practices under Western Canadian conditions, the following descriptions of these experiments may prove of interest.

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TERRACING TO CONSERVE RUN-OFF WATER AND PREVENT SOIL EROSION

A terrace consists of a broad ridge of earth thrown up across the slope of a field and may or may not have a grade in the direction of its length. In throwing up this ridge, a broad, shallow channel is formed along its upper side in which run-off water from higher land is collected. If this channel has a slight grade, the water flows gently to terminal outlets to be carried away. Where no grade is provided, the water held by the terrace may be completely absorbed by the soil. A series of terraces constructed across the slope of a field will aid materially in conserving moisture and preventing erosion.

In the construction of terraces, earth may be graded up from both sides of the terrace line, or from the upper side only. In order to obtain a broad terrace channel, most of the grading should be done from the upper side. This practice, moreover, facilitates construction by moving dirt downhill rather than uphill. Some dirt may be graded uphill, however, in order to secure a terrace which can be readily crossed by implements. In cross-section, a typical terrace may be about 35 feet wide, with the crest of the terrace about 1.5 feet higher than the bottom of the terrace channel. Terraces are most economically constructed with larger tractor-drawn graders, but horse-drawn equipment may be used.

The vertical drop or distance between terraces will depend on the slope of the land, the amount of snow

Basin listing on summerfallow

accumulation and run-off to be expected, and the absorptive capacity of the soil for moisture. It is advisable to secure engineering assistance in the designing of terracing systems.

Inasmuch as terracing involves considerable expenditure for construction, it should be practised only on potentially good cropping land. On grazing land the "ridge" terrace or dyke, which is cheaper to construct, will serve the same purpose.

Much experimental work on terracing has been done in the United States. One objective of this work has been to control erosion caused by occasional very heavy showers. For this purpose terraces are given a slight grade and the run-off water is diverted to suitable ditches for removal. In the Canadian prairies, however, where it is desirable to conserve as much water as possible, level terraces may prove more suitable.

Most of the experimental terracing work conducted so far in Western Canada has been supervised from the Dominion Experimental Station, Swift Current, Sask. Nine experimental terraces were constructed at this Station in 1938 for the purpose of securing data on different grades and terrace intervals. The average height of each terrace is 1.5 feet from bottom of channel to crest of terrace and the width is 34 feet. These terraces were constructed from the upper side only, the borrow pit being the terrace channel.

Five of these terraces were made with no grade, the purpose being to retain as much run-off water as possible. Two were built on constant grades, one of 0.1 feet per 100 feet and one of 0.05 feet per 100 feet. The remaining two terraces have variable grades, that is, the first 300 feet have no grade, the second 300 feet a grade of 0.1 foot per 100 feet, the third 300 feet a grade of 0.2 foot per 100 feet,

and so on until a maximum grade of 0.4 foot per 100 feet is reached.

The area benefited by this terracing scheme is 75 acres. Altogether, 3.2 miles of terrace were constructed, involving the moving of 5650 cubic yards of dirt. A large crawler tractor and a 12-foot blade grader were used for the main part of the construction, and a 35 h.p. crawler tractor and 10-foot blade terracer for finishing.

Other terracing projects have been constructed by the Swift Current Station in co-operation with Agricultural Improvement Associations at Swift Current and at Verlo, Sask. In these projects outlet pipes were placed through the terraces in order that water might pass from upper to lower terraced areas.

In southwestern Manitoba the District Experiment Sub-Station at Boissevain was established in 1937 for the purpose of conducting experiments on methods of crop production on sloping land. The experiments on this station include trials of terraces, contour cropping and various cultural practices designed to conserve moisture and prevent erosion. This work is supervised from the Dominion Experimental Farm, Brandon, Man.

In southern Alberta, contour dykes and ditches have been constructed on nine different areas of sloping land. These dykes serve, like terraces, to check erosion, but are narrower and more cheaply constructed and not necessarily passable by farm implements. Altogether, some 35,200 feet of dyke and ditch were constructed in 1938 by the farmers concerned, with surveying assistance from the Dominion Experimental Station, Lethbridge, Alta.

FLOOD IRRIGATION

Flood irrigation is a method of utilizing run-off water for increasing facilities are available. In general, soil moisture where no water storage flood irrigation is effected by a system of dykes by means of which heavy run-off is spread over the irrigable area and retained thereon until the land has become well soaked. Usually only one irrigation, in the spring, is feasible. The two main types of flood irrigation are described below.

One type of flood irrigation, commonly called the dyking or pond system, is used, chiefly for cultivated crops or hay on flat land which has less than one foot drop per 100 feet. The essential feature of this system is that the water is held in ponds for several days until the land is well soaked. It consists of dykes constructed across the slope of the land on the absolute contour, the dyke ends being run up-grade to prevent lateral escape of the water. The height of the dykes is usually limited by the type of equipment available for construction, but need not be more than 1.5 feet high when settled. For dykes of this height, the depth of water impounded should not be more than 0.9 to 1.0 feet of the dyke. The distance between dykes should be such that the high water mark of one pond reaches the bottom of the next higher dyke, providing for a complete water coverage of the irrigable area. During irrigation water is led to the dyked area by means of a diversion ditch. Small culverts are provided through the dykes so that the water can be drained off when desired.

A second type of flood irrigation involves the use of relatively large dykes located directly in the path of flowing run-off water preferably in a wide flat coulee. The essential feature of this system is that the

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water is forced to flow laterally over the irrigable area by means of the dykes, and is allowed to pass around the ends of the dykes to the next lower area. Because the spring run-off water which flows down the coulee must pass through the system, adequate spillways must be provided at the ends of the dykes as well as culverts through the dykes for drainage. The distance between dykes depends on the height to which they can be economically constructed with the available equipment. An elevating grader or fresno is usually employed for construction.

A number of experimental dyking projects have been constructed by the Dominion Experimental Station at Swift Current. One such project was started in 1937 at Neidpath, Sask., in co-operation with the Rural Municipality of Coulee. Others have been constructed at various points, including Swift Current, the Dominion Range Experiment Station, Manyberries, Alta., and on the District Experiment Sub-station at Canuck, Sask.

CONTOUR FURROWING FOR WATER CONSERVATION ON GRAZING LANDS

The purpose of contour furrows on sloping land is to increase vegetative growth by spreading and retarding the flow of moisture from rainfall or spring run-off water.

The contour furrow is made by a common sulky plough across the slope of the land, following a selected contour, the furrow slice being turned down the slope. While generally made on pasture or range land, they may also be used on cultivated land. The distance between contour furrows will depend on the slope of the land and the expected run-off, 10 feet being a good spacing. Contour lines may be located and staked with an engineer's level.

In the Prairie Provinces, contour furrows serve their purpose best when spreading run-off water from rainfall. In the spring the furrow retains ice and snow which reduces its utility in checking run-off.

Contour furrowing projects are in operation at Swift Current, Sask., on the Dominion Range Experiment Station, Manyberries, Alta., and at a number of other points.

CONTOUR CROPPING

Contour cropping usually takes the form of contour strip cropping. It is a method of control for wind and water erosion as well as a method of conserving run-off water. The width of strip varies from 80 to 200 feet, depending on the slope of the land. The centre line of each strip is usually at a constant elevation. In some cases the crop strips may be separated by terraces or permanent bands of grass. In the crop strips a suitable rotation may be followed, including summerfallow, grains, grasses or even hoed crops, as soil and climatic conditions may warrant. The combined effect of cultivation on the contour, and of alternating various types of crops, is to check and to conserve run-off and thereby to control water erosion and conserve soil moisture. One advantage of contour farming is to keep at a minimum the power required for cultural operations.

The principal difficulty in contour cropping lies in the varying width of strips, which accompany irregularities of topography. Irregular width of strip may interfere with cultural work. In some cases this may be overcome by laying down strips of uniform width, and by seeding down intervening irregular areas to permanent grass.

Experiments with contour cropping are being conducted by the

Dominion Experimental Station, Swift Current, in connection with the terracing work described above. Part of the terraced area on the Station is under contour cropping and part under ordinary cultivation, while a third area is neither contour farmed nor terraced. Yield data from each of these areas will result eventually in much useful information.

As previously noted, experiments on contour cropping are in progress at the District Experiment Substation, Boissevain, Man. At Morrin, Alta., one farmer has adopted contour cropping with assistance from the Lethbridge Experimental Station.

BASIN LISTING

Basin listing, or damming listing, is a cultural operation whereby narrow depressions or "basins" are formed in the soil to serve as reservoirs for water which would otherwise be lost as run-off. Basin listing is usually effected by forming small dams at intervals of about six or eight feet along a listed furrow, the furrows being about three or four feet apart. The value claimed for basin listing is that it will conserve moisture for crop production and prevent the cumulative erosive effect of run-off.

During the fall of 1937 and summer of 1938 trials with basin listers were conducted throughout the P.F.R.A. area. This work was done as part of the P.F.R.A. cultural program by Dominion Experimental Farms located at Brandon, Man., Indian Head, Sask., Swift Current, Sask., Scott, Sask., and Lethbridge, Alta.

Because of the exploratory nature of the basin-listing trials in 1937-38, the experimental procedure differed on the various farms. For this reason the results secured are summarized below under the heading of Stations, rather than for the P.F.R.A. area as a whole.

Brandon, Man.

Preliminary trials were made in the fall of 1937 with a three-furrow damming lister at various points in southwestern Manitoba. Soil moisture determinations made in the following spring at three different locations showed no beneficial result from basin listing, either on level or sloping land. Yield results were made at one point, Boissevain, where wheat on fall basin-listed land yielded only 12.6 bushels per acre, as compared to 18.3, 17.2 and 20.0 bushels on fall ploughed, spring ploughed and summer-fallowed land, respectively. These results would seem to indicate that basin listing is not a beneficial practice in southwestern Manitoba. Results covering a fairly long period of years will be necessary, however, before definite conclusions can be drawn.

Indian Head, Sask.

Several trials with basin listing were conducted in southeastern Saskatchewan with apparently favourable results. Owing to grasshopper attacks, however, no comparable yield data were secured.

Swift Current, Sask.

In the spring of 1938 moisture determinations were made on land basin listed in the fall of 1937, and on adjacent unlisted land, at eleven points in southwestern Saskatchewan. On the average, practically no difference was found in the amount of moisture in basin listed and unlisted land.

Scott, Sask.

Less moisture was conserved on basin listed land at Scott than on comparable unlisted stubble.

Lethbridge, Alta.

In the fall of 1937 a number of farmers in southern Alberta basin listed parts of their summer-fallow land. Various types of listers were used for this purpose. Wherever satisfactory comparisons with unlisted fields were available, tests were made in the spring of 1938 of the depth to which moisture had penetrated, and yield data were secured in the fall. The average depth of moisture penetration at 14 different points was 3.8 feet on basin listed land and 3.0 feet on unlisted land or an average difference of 0.8 feet in favour of basin listing. The average yield of wheat for 14 different points was 21.1 bushels per acre on basin listed land and 20.0 bushels on comparable unlisted land, an average difference in favour of basin listing of 1.1 bushel per acre.

The failure of basin listing to result in appreciable increases in soil moisture or crop yields during the 1937-38 trials, may be attributed to several factors. The principal benefit to be expected from basin listing is the conservation in the soil of rainfall which would be ordinarily lost as run-off. Obviously, this benefit cannot be realized unless heavy downpours of rain are received. Another benefit claimed for basin listing is the retention of snow in the basins. In many cases, however, it has been observed that wind blew snow from basin listed land to a greater extent than from neighbouring stubble land. Possibly the gravest defect of basin listing as a moisture conserving practice lies in its drying effect on the surface soil, due to the relatively great depth of cultivation. On deeply listed land, it was observed that the levelling of dry ridges resulted in a dry seed bed, with poor conditions for seed germination and crop growth. Additional experimental work is necessary to determine the relative effect of these and other factors on the efficiency of basin listing.

SNOWFALL CONSERVATION

Experiments on methods of increasing soil moisture by conserving snowfall were undertaken during the winter of 1937-38 on several Dominion Experimental Stations in the P.F.R.A. area. One object of this work was to prevent the loss of snow through drifting from open fields, either by packing the snow with land rollers, or by ploughing the snow into compact ridges which might trap additional snow. Another object was to cause snow to accumulate on definite areas by means of snow fences.

The results so far secured in much of this work have been somewhat inconclusive. On the Dominion Experimental Station at Scott, Sask., however, some interesting results were secured. At this Station both snow ploughing and snow packing resulted in slight increases in the yield of wheat, while an appreciable increase in the yield of oats was effected by the use of snow fences.

Sub-Stations and Their Relation to Rehabilitation

by

J. C. MOYNAN[1]
and M. J. TINLINE[2]

THE SEARCH for practical and scientific facts which will give greater social and financial security to those dependent upon farming for their livelihood is fundamental to the development of a sound agricultural production policy, or a successfully-planned long-time rehabilitation program. In the process of settlement, lands better suited to grazing and other areas unsuitable for cultivated crops have been brought under the plough and now require special treatment. Their restoration and conservation for the use to which they are best suited presents a rehabilitation problem of great economic importance. Furthermore as time progresses, irrespective of the condition of the soil or the type of farming engaged in, new problems arise and changing phases of old ones develop. In factual studies undertaken, relating to the Great Plains area of southwestern Manitoba, also south and central Saskatchewan and Alberta, three principal types of farming must be considered, namely:—(1) specialized grain growing, chiefly wheat production with little or no live stock; (2) combined grain and stock farming; (3) stock raising with only sufficient crop production to supply feed to supplement the range. The District Experiment Sub-stations have been more actively associated with the problems existing on the two first named types.

The investigation of agricultural production problems has been carried out on the Dominion Experimental Farms since their inception in 1886. This work has been supplemented and brought more effectively to the attention of farmers through outpost units known as illustration stations and district experiment substations, established respectively in 1915 and 1935. These latter units are not operated on government owned land, but on privately owned farms with a co-operative agreement between the owner and the Experimental Farm Service.

Upon the inauguration of the Prairie Farm Rehabilitation Act, provision was made for enlarging the scope of the then existing Illustration Stations in the drought area and renaming them as District Experiment Sub-stations, as well as for the opening up of new units. These Substations, which now number 47, serve as proving grounds where the results of experimental findings may be verified and information on useful practices disseminated. They make it possible to conduct experimental work dealing with cultural studies, soil drifting control measures and other drought problems at points distant from the Experimental Farms and where soil types and seasonal conditions differ. The programs on the Sub-stations are planned to ascertain the best adapted crops and practical uses for land of the different types. Because of the direct relation between weather conditions and farm practice, records are kept of seasonal precipitation. On these family-sized farms, with the co-operation of the owners, a study is made of farm returns, expenditures and security of living. Sub-stations are also actively concerned with such projects as home

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beautification, domestic and stock-water supply, farm gardens established under dry farming conditions or under privately developed irrigation schemes; and the establishment of shelterbelts to adequately protect buildings, paddock and garden. The accumulation of feed reserves to provide necessary forage for stock in adverse seasons is accorded special attention.

This work has been initiated and developed in co-operation with the Experimental Farm officers at Brandon, Man.; Indian Head, Swift Current and Scott, Sask.; Lethbridge, Alta.; and the Division of Illustration Stations, Central Experimental Farm, Ottawa, Ont.

The contribution made to rehabilitation projects and problems by the District Experiment Sub-stations has resulted from the untiring efforts and keen interest exhibited by the operators. The names and geographical locations of these operators are given in the accompanying table. The table also indicates the soil classification of each property, the number of days on which soil drifting has been reported by the operator during 1936-37-38, also for the period 1935-38 inclusive, or since Sub-station work started at each point.

A study of the data referred to in the table may contribute to a better understanding of the problems of wheat growing and general crop production in the dryland farming areas of the three Prairie Provinces, commonly referred to as the P.F.R.A. district. While crop growth is directly related to annual precipitation, it is essential that rains occur throughout the season with sufficient frequency to maintain normal growth. When the precipitation is below the normal requirements of cereal crops, as it will have been noted was the case in several of the districts, conditions

A dugout provides water for the use of the home and livestock. The trees collect drifting snow, which fills the dugout in the spring.

conducive to soil drifting arise during periods of high winds.

STRIP FARMING IN RELATION TO SOIL DRIFTING CONTROL

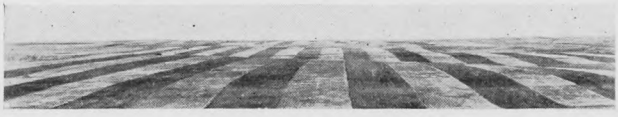
The occurrence of soil drifting on farms in districts where Sub-stations are located varied from 4 to 46 occasions during the period, 1935-38 inclusive. These instances of drifting varied in length from a few hours to five days and frequently were destructive to newly seeded crops through the transfer of soil from adjacent properties where insufficient care was being given to control measures. Due to the very nature of the problem, control measures to be most effective require community action, where each individual for the protection of his neighbour's land as well as his own would employ the best known methods. In the Monarch district of southwestern Alberta, strip farming

Location	Operator	Soil classification	Average annual precipitation Inches	Number of days on which soil drift has been reported in the district
ALBERTA				
Consort	C. A. Fawcett & Sons	Loam (some light loam)	12.91 (4)	9 (4)
Metiskow	E. Masson	Fine sand	14.00 (2)	49 (2)
Bindloss	J. Barnes	Silt loam	8.06 (4)	27 (4)
Cessford	G. Griffith	"Blow-out" loam	11.55 (4)	12 (4)
Claresholm	D. Reynolds	Fine sandy loam	16.72 (2)	59 (2)
Foremost	C. Wolfe	Silt loam	10.81 (3)	15 (3)
Lomond	E. Benson	Clay loam	10.24 (3)	60 (3)
Pincher Creek	D. Cyr	Medium clay loam	18.33 (4)	26 (4)
Whitla	A. Babe	Silt loam	10.83 (4)	11 (4)
Castor	C. Pals	Dark brown prairie soil	15.97 (3)	39 (3)
Drumheller	C. Andrews	Clay	17.30 (1)	9 (1)
Rockyford	A. Kettenbach	Clay	17.22 (1)	9 (1)
SASKATCHEWAN				
Canuck	J. Honey	Haverhill loam and Echo clay loam	12.74 (2)	15 (2)
Carmichael	A. Butler	Cyprus clay loam	13.01 (2)	8 (2)
Fox Valley	C. Mutschler	Fox Valley silty clay loam	7.84 (4)	4 (4)
Gravelbourg	H. Pinsonneault	Fox Valley silty clay loam	11.59 (3)	13 (3)
Herbert	M. Holmes	Haverhill loam	10.67 (4)	50 (4)
Kincaid	W. Phillips	Haverhill clay loam	12.05 (3)	35 (3)
Limerick	W. Smith	Haverhill loam and clay loam	12.09 (3)	16 (3)
Parkbeg	T. Humphrey	Haverhill loam and clay loam	11.76 (4)	8 (4)
Piapot	E. Scherck	Haverhill very fine sandy loam	9.34 (4)	51 (4)
Riverhurst	N. Rudd	Haverhill loam	9.70 (4)	4 (4)
Shaunavon	J. Speirs	Haverhill clay loam	8.46 (4)	32 (4)
Tompkins	J. McEwan	Haverhill fine sandy loam	10.41 (2)	23 (2)
Tugaske	R. Wilson	Weyburn loam and light loam	13.69 (4)	0 (4)
Valjean	F. Linquist	Hatton fine sandy loam	12.37 (4)	11 (4)
Aylesbury	C. MacMillan	Clay loam	14.63 (1)	8 (1)
Alameda	G. & S. Young	Oxbow and Weyburn loam	12.76 (3)	0 (3)
Arcola	A. Craib	Oxbow loam	15.58 (3)	33 (3)
Davidson	R. Lloyd	Weyburn loam	13.16 (3)	0 (3)
Lisieux	O. Prefontaine	Haverhill and Cyprus loam	11.11 (4)	8 (4)
Radville	J. Stockton	Haverhill and Weyburn clay loam	14.64 (4)	46 (4)
Strasbourg	A. Coles	Weyburn clay loam	10.81 (3)	7 (3)
Weyburn	E. Meredith	Weyburn clay loam and Weyburn loam	14.16 (4)	11 (4)
Willow Bunch	G. Boisvert	Haverhill clay loam	14.90 (4)	23 (4)
Kindersley	R. Simpson	Sceptre clay loam	9.18 (4)	14 (4)
Loverna	R. Brumwell	Fox Valley silty clay loam	11.60 (4)	29 (4)
Juniata	A. McMillan	Asquith fine sandy loam	12.45 (3)	30 (3)
Guernsey	C. Snider	Asquith fine sandy loam	12.45 (4)	11 (4)
Rosetown	J. Macey	Silty clay loam	12.62 (3)	27 (3)
Avonlea	J. Miller	Echo clay loam	12.13 (4)	9 (4)
Dunblane	N. R. Stewart	Haverhill loam	11.66 (2)	11 (3)
MANITOBA				
Boissevain	C. Musgrove	Black soil	11.85 (1)	10 (1)
Crystal City	J. Ring	Light loam	10.15 (1)	0 (1)
Goodlands	C. Bell	Medium dark loam	16.69 (3)	18 (3)
Lyleton	J. Parsons	Medium dark loam	13.12 (3)	15 (3)
Pipestone	W. Forder	Sandy loam	17.56 (4)	10 (4)

N.B.—Figures in brackets indicate the number of years represented in the average.

was effectively employed as a community undertaking a number of years ago, and is still the standard basis of farm organization in that area. A study as to the effectiveness of this basic principle in other areas and on different soil types was undertaken on the Illustration Stations at Loverna, Avonlea and Fox Valley, Sask., in 1933. In the spring of 1935, experimental studies in soil drifting control were undertaken on 38 farms now operated as sub-stations and some 13,771 acres of land were laid out for the purpose of pursuing a strip farming program. During the succeeding three years, additional land was divided into strips and the number of Sub-station units increased to 47. At the present time approximately 25,849 acres are devoted to the study of problems associated with this system of farming including such hazards as weed control, invasions of grasshoppers, and the wheat stem sawfly. Since the inauguration of this work and as a result of the effective control measures employed, strip farming has been on the increase in the districts surrounding the Sub-stations at Herbert, Tompkins, Riverhurst, Shaunavon, Carmichael, Canuck, Kincaid, Limerick and Gravelbourg, Sask.; Whitla, Pincher Creek, Claresholm, Rockyford, Lomond and Drumheller, Alta., also Lyleton, Manitoba.

Different widths of strips have been compared in an effort to correlate soil types, textures and control measures. These include 8, 10, 13 1/3, 16 and 20 rod strips. Generally speaking, these strips are laid out in a north-to-south direction particularly in the chinook area of Alberta. On several of the other Sub-stations as at Dunblane, Juniata, Kindersley, Consort, Herbert, Tompkins and Carmichael, Sask.; Rockyford, Castor, Drumheller, Alta.; and Lyleton, Pipestone, Crystal City, Boissevain and Goodlands, Man., in definite areas, strips run in both a north-to-south and east-to-west direction in view of the fact that drifting has been found to occur in these districts from different directions. The effectiveness of each varies with the season. The results to date indicate that 16-rod strips are well suited to the medium or heavy loam soils, but on the light silt loams, narrower strips appear necessary. On the Sub-stations in Alberta and Saskatchewan, these strips for the most part have been ranged to provide for a two-year rotation of fallow and wheat, or a three-year rotation of fallow, grain, grain. In Manitoba, in addition to these, several longer rotations, including hay, are under test.



Strip farming for control of soil drifting

Cultural Methods

The results obtained from the work carried out on the Sub-stations to date indicate that strip farming alone does not control soil drifting. On the other hand, when combined with effective cultural practices, particularly those which bring about a lumpy condition of the soil and retain the stubble and trash on the surface, very satisfactory results have been obtained. During 1935 and 1936, there was little damage to crops from soil drifting on any of the Sub-stations. Any such drifting came mainly from light sandy ridges and adjoining properties. In 1937 conditions were the most unfavourable since

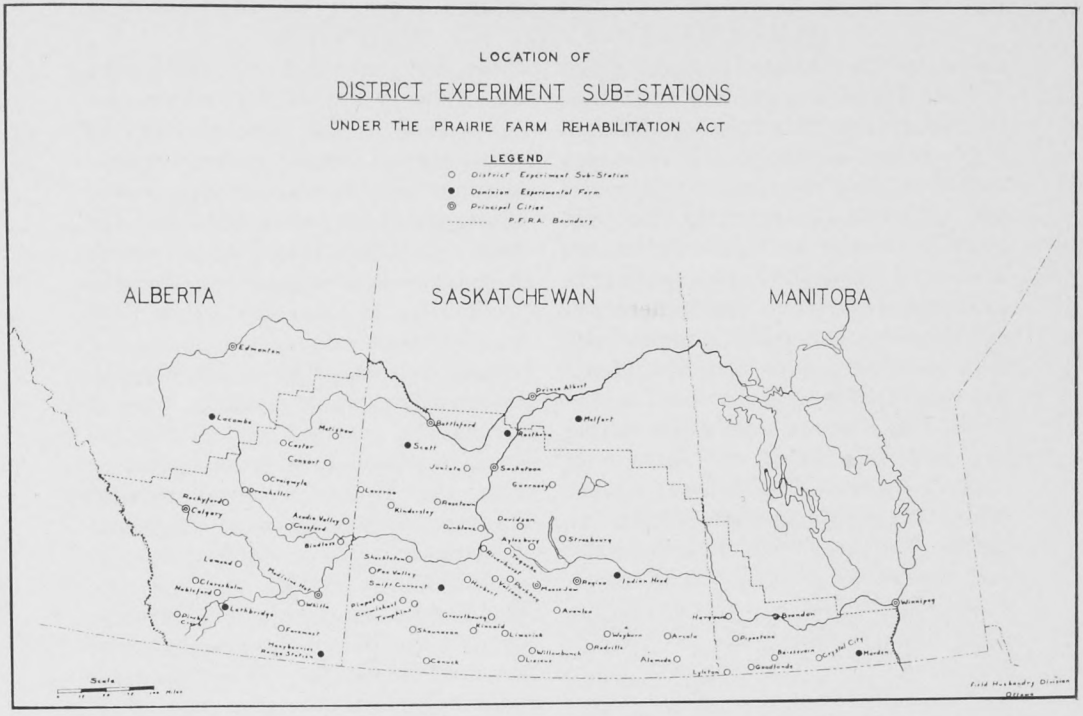
the project started. The season was one of extreme drought with persistent winds. Under these conditions soil drifting was controlled to such an extent that the damage from this cause was not serious, except at Piapot, Fox Valley, Shaunavon and Pipestone, where there was little or no stubble to resist wind action. In 1938 there was one particularly bad wind storm which came at a critical time in the middle of May and extended over a three day period. On the Sub-station little loss of crop or damage resulted. However, each season it has been necessary to resort to emergency measures on exposed areas, such as the spreading of straw or manure, cultivating when the soil was moist, or ridging with the plough or with lister shovels attached to the cultivator. Although definite cultural practices have been developed for the summer-fallowing of land, it is obvious that no hard and fast rule can be applied. It is necessary to study the physical condition of the soil to be worked and the implements available before deciding how each operation is to be carried out. The implements which are now in common use for this purpose include the one-way disk, the duckfoot and the heavy spring-tooth cultivator, the rod weeder and such new implements as the Noble blade weeder. Arising from the work on the Experimental Farms and Sub-stations, it has been found that on the heavy soils and where there is sufficient stubble, the ploughless method of summer-fallowing is increasing. This has resulted from the use of the cultivator and rod weeder, or by the use of the one-way disk for the first cut, working shallow so as not to bury the stubble. On the medium loams where there is little or no stubble, the land may be ploughed so as to bring up moist soil which will be conducive to forming a more lumpy surface. The implement and manner in which it is used will vary with existing circumstances, keeping in mind the objective of bringing about a lumpy condition and the retaining of trash and stubble on the surface of the land being summer-fallowed.

COVER CROPS

Four years experience in the use of cover crops as a means of controlling soil drifting indicates that difficulty has been experienced in securing successful stands, excepting on the Sub-stations at Claresholm and Pincher Creek, Alberta. Generally speaking, slightly reduced yields have resulted from their use. A good cover crop has been found to control drifting; however, under seasonal conditions prevailing during the period in question, the seed has frequently failed to germinate and where it did, grasshoppers thinned the stand and coverage. Adjoining the foothills in Alberta, particularly at Claresholm and Pincher Creek where precipitation has been more abundant, cover crops have protected the soil and supplied late fall and winter pasturage for live stock. Failure of the seed to germinate on dry soils and destruction of the crop by grasshoppers on the stations have resulted in farmers not adopting this procedure as a soil drift control measure in the drought areas of the Prairie Provinces.

SHELTERBELTS

Contentment within the farm home is essential to rural life and future stability. It is, therefore, of fundamental importance that every possible convenience and comfort be provided. All too frequently the value of trees, hardy shrubs and shelterbelts about the buildings, paddocks and gardens has been underestimated.



In addition to protecting the home and buildings from high winds, they accumulate snow for the dry land garden, supplementing the existing moisture supply. Thus the establishment of demonstration shelterbelts is regarded as an essential rehabilitation project on all Sub-stations. This has necessitated the renovation and extension of many of the older plantations as well as the setting out of large numbers of trees for the establishment of new shelters. Both deciduous and coniferous trees have been supplied from the Dominion Forest Nursery Stations at Indian Head and Sutherland, Sask., and have been planted out in keeping with plans prepared and supplied to the operators by these institutions. The kinds of deciduous trees planted included the Manitoba maple, ash, elm, northwestern poplar, willow and caragana. The coniferous trees consisted of white spruce, Colorado spruce and Scotch pine. Since this project was instituted in 1935, some 185,469 trees have been set out on the Sub-stations. In spite of the adverse seasonal conditions prevailing during these years, necessary replacements in Manitoba totalled only 12.4 per cent, in Saskatchewan 19.7 per cent, and in Alberta 15.9 per cent.

SUB-STATION FIELD DAYS

An effort is made to develop the District Experiment Sub-stations into community centres where neighbouring farmers may meet together at least once each season to discuss their problems in the light of the work under way. With this in mind, field days are held on the Sub-stations during the summer season. In this way those present can review the work with the operator and departmental officers present, thus becoming acquainted with the results of the different projects. Considerable time is spent going over the fields and studying the response of the different

crops to the various cultural treatments. These include soil drift control measures, the effect of different implements in promoting a lumpy condition on the summer-fallow and the retention of the stubble on the surface as well as measures for the control of weed and insect pests. The number of farmers attending these meetings has gradually increased and may be regarded as a means of appraising the interest taken in the work. The average attendance during the past four years by districts of supervision was as follows:—Lethbridge 97, Swift Current 125, Indian Head (3 years) 162, Brandon 175, and Scott 205.

The sections in which the Prairie Farm Rehabilitation Act operates stretch over some eight hundred miles of farm lands between the Red river in eastern Manitoba and the Rocky mountains on the west. In this broad expanse of prairie, there are many variations in soil type, in vegetation, and in precipitation. Of necessity, therefore, farm practices must vary greatly in these different areas. It is, therefore, important that the best known farm practices be adopted. Farmers frequently find experimentation costly. The District Experiment Sub-stations are primarily designed to relieve the farmer of this burden and to provide for him the most recent information obtainable on the production of farm crops, on soil conservation, and on the rebuilding of the flocks and herds as individual situations warrant.

Having controlled soil drifting on the lands best suited to wheat production on the Sub-stations, with the operators now largely growers of rust-resistant wheats, at least progressive development has resulted. On the drier and lighter lands, where islands of good soil occur, suitable for the production of forage crops as feed for live stock, a farm-ranch type of set-up offers possibilities through the modification of the existing type of agriculture. Added investigational work is under way in co-operation with the Dominion Entomological Division, for the control of the wheat stem sawfly in a co-ordinated way, applicable to a full farm set-up. Modification in cultural practices, in farm organization and in land utilization has taken place. Continued rehabilitation studies on the Sub-stations may logically be expected to suggest further adjustments in the interest of financial security and the desired permanency of dryland agriculture in the Great Plains area of Western Canada.

PROGRESS OF SMALL . . .

(Continued from page 62)

and the value of these projects if constructed and successfully operated could scarcely be estimated as a means of producing feed and vegetables during periods of low rainfall. It is for these reasons that small irrigation developments in conjunction with dugouts and stockwatering dams constitute a major activity of the P.F.R.A. program.

Forage Crop Expansion

By L. E. Kirk[1] and T. M. Stevenson[2]

In the scheme of rehabilitation for the Prairie Provinces of Western Canada, initiated by the Dominion Government, the many-sidedness of the problem was fully recognized. Hence forage crops have been given a prominent place in the program not only because of their importance in making possible a greater degree of diversification on prairie farms but also because of the soil-conserving properties of grass and legume crops.

Forage crop expansion itself is a many-sided undertaking. Experimental work on a large scale has been necessary to determine which crops can be grown successfully in different sections of the country and under different conditions. The best methods of establishing the small seeded grasses and legumes under dry-farming conditions had to be worked out. Seed multiplication had to be encouraged with an eye to future requirements, and a policy of seed distribution developed. Lastly, and very important, research with forage crops was stressed with the object primarily of developing new and better sorts to satisfy the diverse demands of the situation.

The facilities provided by Dominion Experimental Stations in Manitoba, Saskatchewan and Alberta, and the Dominion Forage Crops Laboratory, co-operating with the University of Saskatchewan, made it possible to promote all phases of forage crop expansion in a well co-ordinated program of work which has already more than justified the effort expended on this phase of the Prairie Farm Rehabilitation Program.

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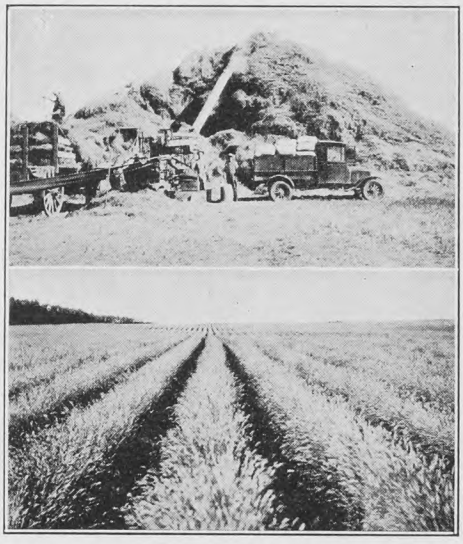
[2]Dominion Agrostologist, Division of Forage Plants, Central Experimental Farm, Ottawa.

Interest in forage crops has increased markedly in recent years. The reasons for this are fairly obvious. Through introduction and breeding, new species and varieties which are better adapted to Western Canadian conditions, have been made available. New methods of seeding have eliminated much of the risk resulting from poor "catches". The necessity of re-grassing the lighter soil types in the drier areas and of restoring root fibre to the heavier soils to prevent drifting, has become more and more obvious. The discovery that certain areas in the Prairie Provinces were highly adapted to the production of grass and legume seeds encouraged many farmers to specialize along this line. Finally, the unfavourable prospect for the sale of wheat in European markets has exerted a strong influence on the farms of Western Canada in the direction of greater diversification.



Below is shown a field of Fairway crested wheat grass at North Battleford, Sask., June, 1938. The threshing of the crop on the same farm as shown above.

PERENNIAL GRASSES

Grasses and legumes highly adapted to western conditions are available for all sections of the Prairie Provinces. It is a fortunate circumstance that this was so at the time that P.F.R.A. work was begun. The grasses include slender wheat grass, brome grass and crested wheat grass; the legumes, alfalfa and sweet clover.

Slender wheat grass, a native species, is much less used than formerly, but brome grass has long enjoyed an excellent reputation as a hay and pasture crop. Although brome grass has been grown successfully in all parts of Saskatchewan and was considered to be a drought resistant grass, experience has shown that it could not withstand the extreme dry weather which prevailed during the last ten years over the greater portion of the treeless plains.

But where brome grass failed to stand the drought, crested wheat grass demonstrated its ability to persist without injury in the driest seasons. In fact it proved to be highly adapted to that part of the prairie West which suffers most from lack of moisture. Under these conditions it compared very favourably with the native range grasses which at one time covered the entire country. The farmers' esteem for crested wheat grass has risen rapidly with each season's experience until today it stands without a rival for regrassing purposes over the entire short-grass plains. Throughout the park belt also crested wheat grass is finding a useful place for pasture purposes.

In those parts of the West, however, where the moisture supply is more favourable, including Manitoba, eastern and northern Saskatchewan, and parts of Alberta, brome grass is still highly regarded for both hay and pasture. It is a valuable grass also for binding sandy soils because of its spreading habit of growth.

Thus there are two well adapted grasses for the Prairie Provinces, crested wheat grass being invaluable in the drier sections of the country where P.F.R.A. is most active, and brome grass for those areas that are less in need of extreme resistance to drought. There are many places where both are being used to advantage either singly or in combination.

HARDY LEGUMES

The two leguminous crops which excel all others in the Prairie Provinces are sweet clover and alfalfa.

Sweet clover is adapted to practically every part of the West. It is a biennial crop which fits well into the short rotation commonly followed. Considerable quantities of sweet clover seed have been used in P.F.R.A. work, especially in Manitoba, but in the drier plains area its use has been restricted by drought causing poor germination of the seed and poor yields of hay. Under these conditions a perennial grass crop is more valuable because of the fibrous root system with its soil binding properties.

Alfalfa, being a perennial deep-rooted legume, exhibits great resistance to drought when once established. The yield of hay, however, is low in very dry seasons. For this reason the acreage of alfalfa has not expanded appreciably on dryland farms in the plains area. But where water conservation schemes of the P.F.R.A. have brought the land under irrigation, alfalfa is invariably the best crop that can be grown.

Alfalfa is highly adapted to the entire park country and adjacent areas, which surround the short-grass plains. There are also many locations throughout the latter where alfalfa

can be profitably grown by virtue of a high water table or excess moisture on lower lying land provided by the spring run-off.

Wherever alfalfa can be grown successfully, except under irrigation, a grass-alfalfa mixture is favoured because it has been shown experimentally and under field conditions that the two are complementary, the alfalfa greatly benefiting the growth of grass. Thus a mixture of brome and alfalfa at Saskatoon has yielded more than twice as much as brome grass alone over a period of very dry years.

CRESTED WHEAT GRASS

Each of the forage crops mentioned above has its own special field of usefulness and together they constitute a valuable asset of P.F.R.A. in its efforts to improve agricultural conditions in Western Canada. Especially is this true in the establishment of community pastures, the regrassing of abandoned and sub-marginal land, and in the fight against soil drifting. In the attainment of these objectives, crested wheat grass is playing a unique part. For this reason, and because it is a relatively new crop in this country, it is appropriate that some further detail should be given as to its origin and special characteristic.

Crested wheat grass is a native of the steppe region or prairie plains of Russia and Western Siberia. Growing on these cold, dry, wind swept plains it has developed a tolerance of drought and of extremes of temperature that makes it well adapted to the climatic conditions of Western Canada. This grass was introduced to America in 1898 by Professor N. E. Hansen of the United States Department of Agriculture, and was then tested at many different stations. It did not receive much attention until recent years, when it was found to give good results under dry conditions in the tests at Dakota and Montana stations.

In 1915, a small quantity of seed was obtained from the United States Department of Agriculture by the University of Saskatchewan and planted in experimental plots. Following this, introductions were obtained from Russia and Siberia, and also from Mandan, North Dakota. In 1927, seed was obtained from Montana by the Dominion Range Experiment Station at Manyberries, Alberta, and planted in test plots at that station. During the last ten years a large amount of seed has been distributed throughout Western Canada in order that this grass might be tested under a wide range of soil types and climatic conditions.

A variety of crested wheat grass called "Fairway" was developed about fifteen years ago at the University of Saskatchewan. Nearly all of the seed produced in Western Canada is of this variety. The merits of this strain consist in its fine stems and leaves, its non-tufted habit of growth and especially its ability to thicken into a close sod. The heads are typically short and broad, and the seed is relatively small.

Crested wheat grass is suited to a wide range of soil types but is limited in its adaptation to northern latitudes (or high altitudes) and relatively dry areas. The former ensures a cool climate and the latter a low humidity, both of which seem to be most favourable for normal growth. It grows best during the cool weather of the spring and fall months, while during the hot weather of mid-summer growth is retarded and the foliage may turn brown. Nevertheless it is never injured by drought and quickly turns green with the return of moisture and cooler weather.

This grass develops a remarkably strong root system which takes complete possession of the soil. The fibrous roots extend laterally close to the surface and penetrate to a depth of seven and eight feet. With such an extensive root system it is able to effectively compete with weeds. By numerous measurements it has been shown that crested wheat grass can restore to cultivated land the original content of root fibre in prairie soils in comparatively few years.

NEW SEEDING METHODS

Nothing has done more to promote grass culture in the drier sections of the West than certain discoveries that have been made with respect to methods of seeding crested wheat grass. These may appear elementary but they are vital considerations in securing good catches under prairie conditions especially in dry seasons.

Shallow seeding on firm soil done in the fall or very early spring are the main essentials. One-half inch is the proper depth to seed. Crested wheat grass will not emerge if planted deeper than one inch. Seeding with a disk drill is more reliable than broadcasting, and firmness of soil is therefore doubly important because of the danger of too deep seeding. In order to promote shallow seeding all pressure should be removed from the seeder disks. Clean crested wheat grass seed will run through the drill without being mixed with any other material, but the drill should be watched to see that none of the feeder cups become clogged.

Fall seeding or very early spring seeding have given excellent results but all other times are risky. Time of seeding is an important factor. The seed of crested wheat grass germinates at low temperatures and the seedlings become established much better in cool weather. When the roots have penetrated to three or four inches the plants are safe, but the seedlings readily succumb in the early stage of growth if the tiny rootlets should be dried out in the top inch of soil.

Fall seeding has been more uniformly successful than spring seeding. Early fall seeding gives best results if there is sufficient moisture to germinate the seed, but otherwise the best time is just before freeze-up. When seedlings become well established in the fall they continue their growth the following season and thus are much further advanced than seedlings which start in the spring.

Because of the success which has attended these seeding methods it is now a common practice to drill the seed into stubble land or weedy abandoned land with little or no seedbed preparation. A light disking before seeding is sometimes advisable. The presence of stubble and weeds is often a valuable protection for the seedlings against injury from soil drifting while they are becoming established in the spring.

These seeding methods apply especially to the drier prairie sections of the West. A nurse crop under these conditions is highly inadvisable. But under favourable moisture conditions good catches of crested wheat grass can often be obtained when seeded with a crop of grain in the spring. Early seeding is equally important and too deep seeding must be avoided. The latter can best be secured by first seeding the grain and then the grass seed, which should be drilled crosswise of the grain and with special attention to shallow seeding.

SEED PRODUCTION AND UTILIZATION

Encouragement of seed production received the attention of the Government as a part of the P.F.R.A. pro-

gram. Funds were made available for the purchase of substantial amounts of registered and certified seed of crested wheat grass, brome grass, alfalfa and sweet clover. This seed was supplied in limited quantities to farmer growers for seed production purposes under a Dominion plan of forage crop seed distribution.

Under this policy, which was expanded from year to year, supplies of crested wheat grass and alfalfa seed in particular were rapidly increased until in 1938 the estimated production of the former was 2,300,000 pounds and of the latter 3,000,000 pounds in the three Prairie Provinces. In spite of this phenomenal increase in crested wheat grass seed, abnormally high prices prevailed until the fall of 1938. These high prices, due largely to heavy exports to United States, seriously restricted the use of this grass seed by private growers, but did stimulate seed production, until now for the first time it is available in quantity at a price at which farmers can afford to make purchases.

As the domestic supplies of grass and legume seed increased under the P.F.R.A. policy of seed distribution, less seed was distributed for seed production purposes and larger quantities were utilized for experimental, demonstrational, reclamation and regrassing projects. The activities of P.F.R.A., along each of these lines, are discussed in other papers of this symposium.

FORAGE CROP RESEARCH

Continuous support of research has been an integral part of the forage crop program under P.F.R.A. Such investigational work has stressed plant breeding at the Division of Forage Plants, Central Experimental Farm, Ottawa, and its Branch Laboratory at the University of Saskatchewan. Various other investigations by the Dominion Forage Crops Laboratory at Saskatoon and Branch Experimental Stations in the three Prairie Provinces have contributed very materially to the success of the forage crop expansion program. Several important original contributions to our knowledge also have already come out of this work.

Among the most important of these should be listed the development of suitable techniques for establishing the small-seeded grasses and legumes under dryland conditions, especially crested wheat grass. This has been referred to in a previous section of this paper.

Real progress has been made in the field of plant breeding with grasses, legumes and other crops. Mention should be made in this connection of Parkland brome grass, a new variety with dense, leafy foliage and an absence of the strongly spreading habit of growth, which is characteristic of this species. New selections of crested wheat grass have been obtained which show much promise. Strains of large-seeded, perennial wheat-grasses have been developed by crossing various species of wheat with *Agropyron* species which are closely related to couch grass. Among the legumes, alfalfa, sweet clover and soybeans have been worked with intensively. A self-tripping variety and promising pasture types of alfalfa are being tested and increased. New strains of sweet clover have been developed by crossing the Alpha variety with larger-growing sorts, in order to increase plant size and vigour of growth. Extra early soybean varieties have resulted from hybridization, the earliest of which can be produced successfully in certain parts of Western Canada, notably in southern Manitoba.

Many studies of a fundamental nature have been under way for some time. A partial list of these should include the following: breeding of sweet clover of low coumarin content: seed-setting in alfalfa and sweet clover; seed-coat permeability in sweet clover; occurrence of selenium in western range plants; relative value of different grasses for restoring soil fibre; and value of including legumes with grass in hay and pasture mixtures.

From this brief resume of investigational work, it will be seen that substantial contributions are being made towards aiding forage crop expansion. It has been the policy of P.F.R.A., not only to support this work wholeheartedly but also to take full advantage of the progress which has been made in carrying out the rehabilitation programs in Western Canada.

SOIL SURVEYS AND . . .

(Continued from page 13)

Among these problems are: the availability of plant food under different systems of cropping; methods for reclaiming and improving the fertility of eroded soils; the maintenance of fibre in the soil; the movement of soluble salts under irrigation and their effect on crop growth; the soil and meteorological factors that affect moisture conservation and its utilization by crops; the effect of different cultural and cropping methods on moisture conservation; the effect of windbreaks; the fundamental causes of soil drifting; the effect of various cultural and cropping practices on the structure of the soil; methods for reducing the velocity of wind at the surface of the ground.

In connection with nearly all of the above mentioned lines of investigation a considerable amount of time has been required in determining the most suitable methods of attacking the various problems. Special mention might be made of the pioneer work being done on the use of wind tunnels for studying the problem of soil drifting.

Co-operative Soil Research

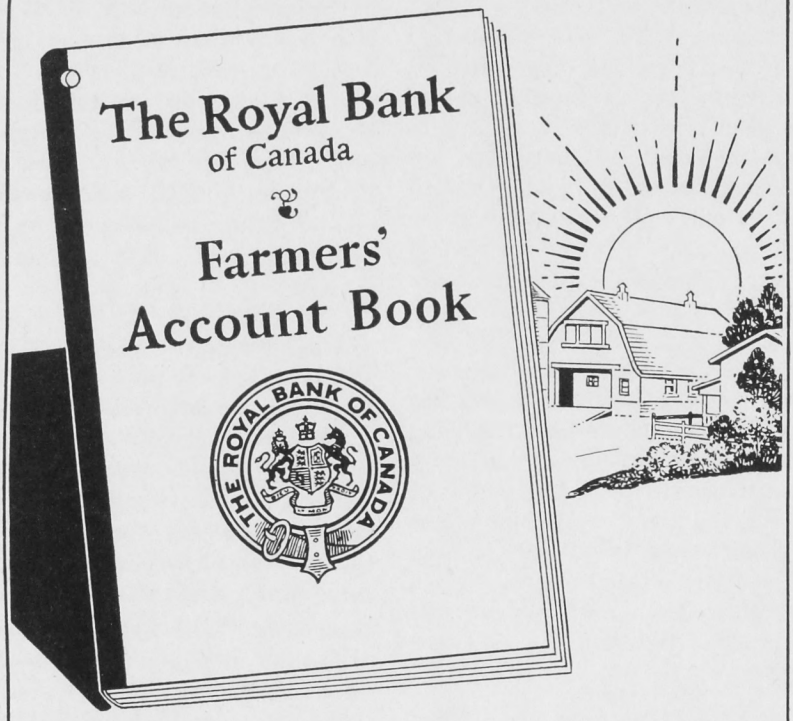
This research is carried on by the Departments of Soils at each of the three provincial Universities and is supported by means of grants from the P.F.R.A. The problems assigned for study to these departments by the joint committee which apportioned the various phases of research being aided under the Act, are as follows:

Manitoba. "The Quality and Composition of Crops as Influenced by Soil Type, Fertilizer Treatment, Crop Sequence, and Climatic Conditions".

Saskatchewan. "The Nature and Significance of the Soluble Salts in Alkali Soils".

Alberta. "The Effect of Cultivation and Cropping on the Chemical Composition of Representative Western Canada Soils".

These investigations at the Universities are more in the nature of fact-finding surveys on problems for which basic information is lacking than investigations leading directly to the solution of specific problems. As such they have already yielded valuable data which will be useful in directing future investigational work on some of the soil problems affecting crop production in Western Canada.



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Tree Planting Under the P.F.R.A.

by

NORMAN ROSS*

IT HAS long been recognized that trees are a necessary factor in building up permanent homes. This is especially so in connection with the prairie farm where generally speaking natural tree growth is completely lacking over immense areas. Because of the very limited number of varieties of sufficient hardiness to withstand the severity of weather and soil conditions, much labour and patience is necessary to develop a prairie plantation.

Special efforts have been made for many years by the Dominion Government to encourage tree planting on prairie farms. On the whole these efforts have met with very good success. The full value of shelterbelts, however, had hardly been realized until the present drought period started about ten years ago.

The most striking benefits have been obtained by farmers during these dry years in producing vegetables and fruits where their gardens have been sheltered by well established tree belts even in districts where there have been complete crop failures. In many cases, too, yields from forage and grain crops have been noticeably increased where protection has been afforded by tree shelters. It is now generally recognized that some form of shelter is absolutely necessary in order to raise garden crops and fruits with any degree of success on the prairie farm.

In addition to their general aesthetic value, which means so much to the comfort and amelioration of life on the prairies, trees afford many practical benefits such as:—

1. Protection from the mechanical force of wind storms to buildings, crops and live stock.
2. The collection of snow which will afford additional moisture in the spring.
3. The holding back of snow from drifting into barn yards and around the farm buildings.
4. They attract birds and provide protection for poultry.
5. Older plantations will furnish plenty of summer fuel and material for odd repairs and fence posts.

When the Prairie Farm Rehabilitation Act was brought into being the encouragement of farm tree planting was included among the various items on the program. Special assistance has been given as follows:

1. To members of Agricultural Improvement Associations in establishing shelterbelts around gardens and buildings.
2. To members of special Field Shelterbelt Associations.
3. To operators of Illustration and Experiment Sub-stations.
4. Reclamation project at Melita in Manitoba.

Agricultural Improvement Associations.

From the inception of this work up to and including 1938 all members of Agricultural Improvement Associations who desired to plant home shelterbelts were provided with the necessary planting material free of charge and transportation prepaid provided the land had been properly prepared and favourably reported on by the Tree Planting Supervisors.

*Superintendent, Forestry Station, Indian Head, Sask.

Field shelter belts of caragana, planted in 1935. Photographed in July, 1938, at Conquest, Sask.

Payment was also allowed to cover the cost of planting the trees on a basis of $3.50 per thousand.

Commencing with the spring of 1939 this planting payment has been discontinued, the policy now being to pay express charges on all shipments of trees going out to farmers in the designated drought area, not confining this privilege to members of Agricultural Improvement Associations only. The percentage of members interested in tree planting is comparatively small although the numbers are increasing each year and undoubtedly will increase very materially as soon as general moisture conditions get back to normal.

In 1938, 909,000 trees were furnished to A.I.A. members and in 1939, 1,277,700 to 1700 members. Generally speaking, in spite of very unfavourable weather conditions, reports indicate that most of the plantings can be considered as reasonably satisfactory.

Field Shelterbelt Projects.

There are four of these situated at:

1. Porter Lake in east central Alberta.
2. Conquest in central Saskatchewan.
3. Aneroid in south central Saskatchewan.
4. Lyleton in southwestern Manitoba.

The idea of these projects is to determine as far as possible to what extent the planting of shelters at reasonably close intervals over a fairly compact area will control soil drifting and benefit field crops in other ways. There is a great diversity of opinion on the value and practicability of such field shelters and no accurate information is, at present, available. It is hoped that when the shelters on these projects are sufficiently developed they will provide very useful information as to the value or otherwise of this type of planting.

The Conquest Project.

This project includes an area 7 by 9 miles and the Shelterbelt Association consists of 74 members. The first hedges were set out in the spring of 1935 and have been added to each succeeding spring. There are now 363 miles of field shelters, practically all caragana, planted in this area. Development has been slow on account of almost continuous drought and repeated grasshopper infestations. In spite of these conditions results are quite encouraging so far as survival is concerned.

The Lyleton Project.

The area covered is 6 by 7 miles and there are 56 members in this association. Planting did not get under way in this project till 1937 when conditions were very dry, and hoppers and blister beetles extremely numerous. Development of the hedges as a consequence has been very slow but they are now becoming fairly well established. The prevalence of blister beetle in this district may make it necessary to use more maple and ash in the belts instead of relying principally on caragana. Ninety-three miles were planted in 1938 and 60 miles in the spring of 1939 bringing the total to 225 miles.

The Aneroid and Porter Lake Projects.

These are considerably smaller and the farms on which planting has been done more scattered than at Conquest and Lyleton. The Porter Lake

plantings have done exceptionally well since the start in 1936. A total of 23 miles is now well established. At Aneroid drought conditions have been exceptionally bad until last year and the first plantings were a near failure. However, the hedges set out in 1937 and 1938 are making a fair start. A total of 38 miles of planting was completed in 1939.

In these four projects 649 miles of field shelters have been now set out so that the main plantings are almost completed. The assistance granted to the members of these Field Shelterbelt Associations consists of:

1. Free material — transportation prepaid.
2. Payment of $3.50 per thousand for planting.
3. Payment of $20.00 per mile per year for cultivation and maintenance for a period of five years from the time a belt is first set out.

Illustration and Experiment Sub-stations.

The idea is that at each of these stations object lessons to the farmers in the adjoining district as to the arrangement, cultivation and maintenance of farm shelterbelts should be demonstrated. Trees have been supplied to 98 of these stations in the three provinces with the plantings now practically completed. Reports indicate that in practically all cases the plantings have come along well, that the operators are interested in the work and are taking good care of the belts.

The Melita Reclamation Project.

One quarter section on this project has been surrounded with a four-row belt of trees planted in 1936 and subdivided by three single row cross hedges of caragana. This planting looked very well in 1938 although grasshoppers had done considerable defoliating.

Highway Planting in Manitoba.

Although strictly speaking not a P.F.R.A. project, these plantings are of very considerable interest. They are being carried out by the Highways Department and have for their main object the replacing of temporary snow fences with permanent hedges of caragana. Some 400,000 caragana have been supplied for this purpose during the past three seasons and show wonderfully good survival and development. A special agreement is entered into between the Highway Department and the owner of the land to ensure proper care of the hedges. The hedges are planted back five or six rods from the edge of the highway and in addition to holding back snow will afford considerable protection to the fields and add greatly to the general attractiveness of the highways.

LAND UTILIZATION . . .

(Continued from page 25)

Judging from last year's operation, these pastures will be well patronized and will provide an increased revenue for the settlers. It is evident that when these areas are all carrying their full live stock quota the municipalities involved will be in a better financial position and the poorer land will be used for grazing purposes for which it is best adapted. In other words it is obvious that these pastures will greatly benefit the individuals who make use of them; will make for greater municipal stability and will be a benefit to the province as a whole.

Prairie Farm Gardens

by

W. R. Leslie*

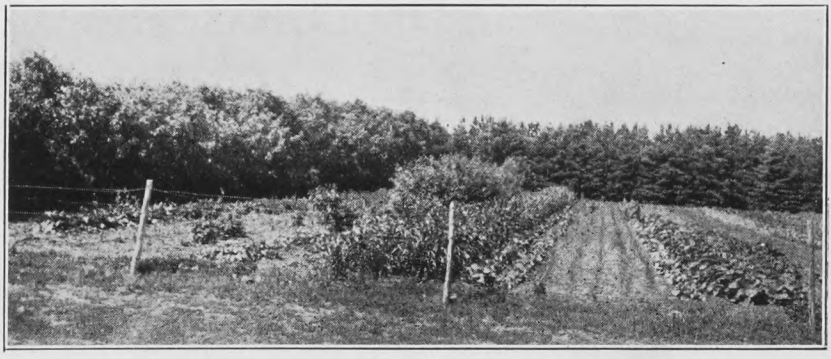
The production in prairie farm gardens of sufficient vegetables and fruits to make farmers independent of outside supplies for domestic consumption, especially in seasons of field crop failure, is an important objective of the Prairie Farm Rehabilitation program. Experiments conducted on Experimental Farms, District Experiment Sub-Stations, and Illustration Stations at a large number of points have demonstrated that prairie farm gardens may be operated successfully even in dry seasons, provided certain precautionary measures are taken. These measures include the protection of the garden from strong winds and soil drifting by means of shelterbelts, the conservation of soil moisture by summer-fallowing, and the use of irrigation water from a dugout or dam wherever possible. Under the P.F.R.A. various forms of assistance are available to farmers who wish to maintain gardens. This assistance includes the provision of free trees for shelterbelts, financial aid in constructing small irrigation facilities, and the advisory services of the Dominion Experimental Farms.

A suitable prairie farm garden might cover two acres of land. Of this area 1.5 acres would serve as a vegetable garden, one-half under vegetables and one-half in summer-fallow each year. The remaining half acre would be used for fruit trees and perennial garden crops.

The fruit garden may run down one side of the two vegetable gardens for economy of cultivation or it may be separated from them by a hedge. It has been demonstrated in convincing manner, over the entire wheat-growing prairies, that every farm may have a productive planting of fruits. At the Morden Experimental Station, three crops are always generous. They are gooseberries, sandcherry and choke cherries. At Morden, there is no record of a complete failure of apples, plums, pears, apricots, cherries, grapes, currants, raspberry or strawberries but these fruits all suffer, more or less, from seasons of drought, disease, insects or frost injury.

Farms on the deeper prairies to the northwest where altitudes are greater and temperature more extreme, find the range of fruit is more limited than at Morden. However, adapted crab apples, sandcherries,

*Superintendent, Dominion Experimental Station, Morden, Man.



A well sheltered prairie farm garden

plums and berries are available for every territory considered as reliable for growing hard wheat and corn.

The prairie garden yields its first crops in late April or early May from perennial onions, chives, parsnips wintered over in the soil, and sharpleaf dock. Asparagus follows soon after. Fresh vegetables are taken from the soil until freeze-up and from the cellar winter garden until the following spring.

The perennial vegetable garden includes rhubarb, asparagus, Jerusalem artichoke, sharpleaf dock, or Belgian spinach, winter onions, chives, perennial celery (for culinary purposes) and possibly horse-radish. The last named has an adverse straying tendency and is apt to become a weed nuisance from its sucker growths. If it is wished, it is well to grow it in an enriched mound surrounded by a dug ditch to restrain it.

Rhubarb is suitable for growing in prairie gardens, Ruby, Macdonald, Sunrise, Coulter and Canada being satisfactory new varieties.

Annual vegetables have been improved nearly all down the line. Melons from Poland and the far East have enabled melons of pleasing quality to be ripened over much of the prairies in sheltered gardens.

Carrots with small red cores are more nutritious and palatable than the old-time Chantenay. New tomatoes which are all red, even around the stem are attractive. Some hybrids are determinate in growth, eliminating the chore of pruning. Some are nearly solid meat with few and small seeds. Several varieties introduced lately yield satisfactory crops when

(Continued on page 101)

Insect Surveys in the Rehabilitation Program

by

H. L. Seamans*

Few people realize the important part that insects can play in the rehabilitation program now being conducted under the P.F.R.A. It is quite safe to say, however, that the wheat stem sawfly (*Cephus cinctus* Nort.) is one of the most serious of the stumbling blocks in the path of successful soil drifting control operations. Areas in which this insect occurs cannot be safely strip-farmed without adopting measures for its control. In some localities where strip farming was started without considering the wheat stem sawfly the farmers have been forced to abandon the practice and take their chances on other methods of soil drifting control.

The rapid increase and spread of Say's grain bug (*Chlorochroa sayi* Stal) may curtail the general use of trash-cover summer-fallow. While a properly done trash cover is an excellent aid in controlling soil drifting, it also furnishes ideal hibernating quarters for the overwintering Say's grain bugs, greatly reducing the winter mortality of this insect and allowing the maximum emergence of adults in the spring.

The investigations on these two insects are being conducted by the Lethbridge Entomological Laboratory. During the seasons of 1937 and 1938, surveys were carried on in co-operation with the P.F.R.A. to determine the distribution and abundance of these two pests in Saskatchewan and Alberta. The information secured from these surveys was then made available to P.F.R.A. workers so that recommendations for soil drifting control could be made without inviting more serious trouble from these insects.

*Officer-in-Charge, Dominion Entomological Laboratory, Lethbridge, Alta.

THE 1937 SURVEYS

The severe drought of 1937 and the subsequent lack of suitable host plants did much to reduce the wheat stem sawfly in many areas in southern Saskatchewan and Alberta. A detailed survey was made throughout the rehabilitation area in both provinces to determine the degrees of infestation and outbreak probabilities of the wheat stem sawfly for 1938. The results of this survey were then mapped to show those areas where strip farming could be safely recommended without first establishing a sawfly control program, as well as the areas where such a procedure would be disastrous.

While making the sawfly survey, observations were made on the distribution of Say's grain bug. These observations showed that the bug was present over the southern fourth of both provinces. The only area where the bug was present in serious numbers was that portion of Alberta lying south of the Crow's Nest line of the Canadian Pacific Railway. The survey also indicated that isolated outbreaks may occur almost anywhere in the southern prairie areas, as the insect is capable of extensive migration and flights of large numbers of bugs were encountered some distances from previously known infestation centres.

THE 1938 SURVEYS

A survey of the same two insects was conducted in 1938, with the area extended northward in an attempt to find the limits of infestation. The more favourable crop season and an abundance of suitable host plants gave the

wheat stem sawfly a chance to increase and spread in areas where it was found only locally in 1937. There still remained a considerable extent of southern Saskatchewan in which strip farming could be safely recommended without having to consider the wheat stem sawfly infestation.

Say's grain bug was found to have increased in southern Alberta, and isolated specimens were found scattered over the two provinces as far north as Saskatoon in Saskatchewan and Drumheller in Alberta. Concentrations of large numbers were found throughout the southern portion of Alberta where they occurred in 1937, and in addition, local outbreaks of some severity occurred in the Retlaw and Lomond districts north of the Old Man river.

Control Measures for Wheat Stem Sawfly

In areas where brome grass can be grown, seeding road allowances and headlands to this grass provides an excellent permanent control for the wheat stem sawfly. The flies readily lay their eggs in brome but the larvae do not mature in it except in dry seasons. Wheat seeded in a strip 20 feet wide and separated from the main crop by 20 feet of bare summer-fallow makes an excellent seasonal trap crop for wheat stem sawfly. The trap wheat must be seeded about a week ahead of the main crop and cut for hay between July 10 and 20 to destroy the larvae before they mature.

Control Measures for Say's Grain Bug

There are no adequate control measures for Say's grain bug, but infestations can be reduced by measures directed against the insects as they come out of hibernation in the spring. Ploughing down to a depth of more than five inches weeds and trash in which the bugs are congregated will destroy many of them. Burning weed accumulations which are harbouring bugs along ditches, in fields and fence rows in the spring is also of value in reducing the numbers.

The Effect of Grasshoppers

Grasshoppers may affect the rehabilitation program by destroying cover crops seeded in August to prevent winter soil drifting and by destroying new grass in the regrassing program. Experiments conducted by the Division of Entomology indicates that poisoned bait moistened with oil instead of water is particularly effective in the control of grasshoppers in areas that are being constantly reinfested. The oil bait remains attractive to grasshoppers for a longer time than water bait, and in the late summer when grasshoppers are seeking fresh green growth for food, cover crops and new grass stands are particularly attractive. One application of oil bait has protected late green crops for six weeks when water bait had to be spread every three or four days to give adequate protection.

Insects Affecting Alfalfa

Another survey was made in 1938 by Dr. Salt of this laboratory, who is conducting investigations on insects affecting alfalfa and clover. The opening-up of new irrigation projects and the agricultural development of the grey wooded soil areas have greatly increased the acreage devoted to alfalfa. This new acreage may be threatened with insect outbreaks which will come either from the increase in the numbers of some species native to that locality or from migrations from the older alfalfa-growing districts.

During the summer of 1938 Dr. Salt made insect collections throughout the alfalfa-growing areas of Alberta and Saskatchewan. The greater part of this material has been determined, and some of those species which are of economic importance in the older areas are found to be present in the localities where alfalfa has been grown for only a year or two. Other species which may be important occur in restricted localities, more of them being present where alfalfa has been grown for several years. Future surveys will show the importance of these species and whether or not they are increasing and spreading.

The annual surveys and forecasts of grasshopper conditions made by the Division of Entomology have proved their value to the farmers. These have made it possible for cultural control programs to be adopted wherever necessary, and have also shown where bait supplies would be needed to supplement the cultural control. In most cases the control campaign is able to prevent losses which, if not curtailed, would seriously aggravate the rehabilitation program.

PRAIRIE FARM . . .
(Continued from page 98)

seed is sown in the garden the second week of May. Spinach varieties with thick leaves and the merit of reluctant seed setting are recommended. Hybrid lettuce of heading type such as Little Gem prolongs the season for the home-grown product. Disease-resistant varieties of beans, peas, corn, asparagus, cucumbers, watermelons and celery have resulted from the efforts of skilled plant breeders.

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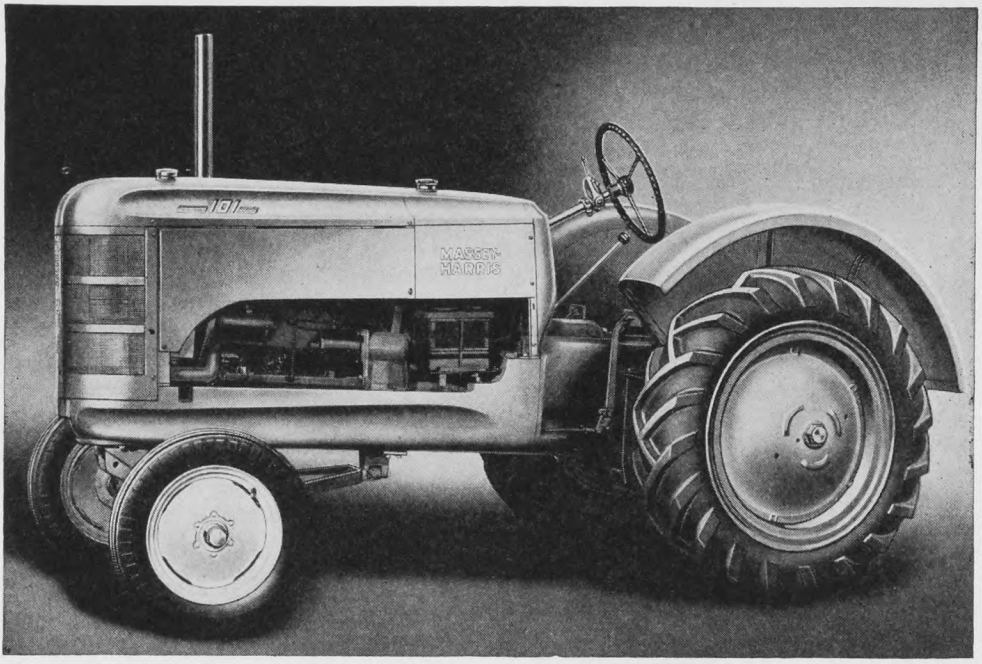

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